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

AES Sustainability Consultants

Property Reference	4907-P637-6633-302	**Issued on Date**	19/10/2022
Assessment Reference	Plot 302	**Prop Type Ref**	Stafford-As-DET
Property	Plot 302, 4 Bed, K, WC, B, En, Ut		

SAP Rating	84 B	**DER**	16.96	**TER**	17.07
Environmental	84 B	**% DER<TER**	0.66		
CO_2 Emissions (t/year)	1.87	**DFEE**	52.63	**TFEE**	60.73
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.33		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-303	**Issued on Date**	19/10/2022
Assessment Reference	Plot 303	**Prop Type Ref**	Ebbertson-As-SEMI
Property	Plot 303, 3 Bed, K, WC, B, Es		

SAP Rating	85 B	**DER**	16.22	**TER**	17.47
Environmental	86 B	**% DER<TER**	7.14		
CO_2 Emissions (t/year)	1.51	**DFEE**	48.02	**TFEE**	55.35
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.25		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 112 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.47 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.22 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.0 kWh/m²/yrOK
---
2 Fabric U-values

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

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

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

Hot water controls: No cylinder

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

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

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

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

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6. Solar gains

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

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

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3812	32.4772	32.5718	33.0237	33.1096	33.5156	33.5156	33.5919	33.3581	33.1096	32.9362	32.7569	
alpha	3.1587	3.1651	3.1715	3.2016	3.2073	3.2344	3.2344	3.2395	3.2239	3.2073	3.1957	3.1838	
util living area	0.9903	0.9829	0.9643	0.9162	0.8223	0.6787	0.5383	0.5973	0.8165	0.9508	0.9846	0.9920	(86)
MIT	18.8637	19.0952	19.5098	20.0578	20.5225	20.8259	20.9398	20.9150	20.6584	20.0343	19.3547	18.8304	(87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511	(88)
util rest of house	0.9884	0.9794	0.9568	0.8976	0.7813	0.6029	0.4302	0.4897	0.7581	0.9363	0.9809	0.9904	(89)
MIT 2	17.0740	17.4124	18.0142	18.8027	19.4380	19.8222	19.9371	19.9203	19.6353	18.7849	17.8003	17.0317	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6266	17.9320	18.4759	19.1902	19.7729	20.1321	20.2466	20.2274	19.9512	19.1707	18.2802	17.5870	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4766	17.7820	18.3259	19.0402	19.6229	19.9821	20.0966	20.0774	19.8012	19.0207	18.1302	17.4370	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9813	0.9689	0.9406	0.8768	0.7657	0.6037	0.4441	0.5014	0.7468	0.9182	0.9711	0.9843	(94)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful gains	546.1302	637.1988	733.5624	805.8681	776.8566	607.9303	425.2935	437.1043	569.6516	580.4387	530.4041	515.4138	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1740.7013	1696.7534	1553.1357	1313.5177	1023.6294	686.9373	446.2925	468.2986	731.1067	1087.9470	1432.6018	1728.6341	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	888.7609	712.0207	609.7625	365.5078	183.5989	0.0000	0.0000	0.0000	0.0000	377.5861	649.5823	902.6359	(98)
Space heating												4689.4551	(98)
Space heating per m2											(98) / (4) =	41.6989	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5181.7184	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	888.7609	712.0207	609.7625	365.5078	183.5989	0.0000	0.0000	0.0000	0.0000	377.5861	649.5823	902.6359	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	982.0563	786.7632	673.7708	403.8760	202.8717	0.0000	0.0000	0.0000	0.0000	417.2223	717.7705	997.3877	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9459	89.9033	89.8044	89.5732	89.0934	87.3000	87.3000	87.3000	87.3000	89.5701	89.8454	89.9662	(217)
Fuel for water heating, kWh/month	199.6072	175.0983	181.9258	160.4875	155.9101	138.9421	130.3772	147.2980	148.3736	166.5721	179.3733	193.7477	(219)
Water heating fuel used												1977.7129	(219)
Annual totals kWh/year													
Space heating fuel - main system												5181.7184	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												7695.0334	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5181.7184	0.2160	1119.2512	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.7129	0.2160	427.1860	(264)
Space and water heating			1546.4371	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/year			1824.4147	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.2200	(273)

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

DER		16.2200	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		32.3746	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.3746	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

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

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9992	0.9981	0.9940	0.9751	0.9098	0.7586	0.5884	0.6560	0.8990	0.9890	0.9983	0.9994	(86)
MIT	19.6874	19.8287	20.0876	20.4431	20.7519	20.9362	20.9864	20.9769	20.8315	20.4232	19.9957	19.6693	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9989	0.9975	0.9917	0.9649	0.8725	0.6710	0.4652	0.5314	0.8420	0.9830	0.9976	0.9992	(89)
MIT 2	18.2139	18.4226	18.8021	19.3233	19.7447	19.9650	20.0043	20.0015	19.8587	19.3022	18.6766	18.1953	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6688	18.8567	19.1990	19.6691	20.0557	20.2649	20.3075	20.3026	20.1590	19.6482	19.0839	18.6504	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6688	18.8567	19.1990	19.6691	20.0557	20.2649	20.3075	20.3026	20.1590	19.6482	19.0839	18.6504	(93)

8. Space heating requirement

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

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

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

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

Solar gains	108.3210	211.8292	350.4277	516.2089	638.9017	657.2044	624.3542	531.8152	408.9957	251.6102	135.0087	89.1363	(83)
Total gains	522.1154	624.0649	748.0371	889.7046	986.7251	981.3389	933.7947	845.5244	735.7179	602.5939	513.8598	490.0294	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8392	31.9336	32.0266	32.4709	32.5554	32.9547	32.9547	33.0297	32.7997	32.5554	32.3849	32.2086	
alpha	3.1226	3.1289	3.1351	3.1647	3.1704	3.1970	3.1970	3.2020	3.1866	3.1704	3.1590	3.1472	
util living area	0.9915	0.9845	0.9669	0.9204	0.8291	0.6879	0.5479	0.6092	0.8261	0.9550	0.9864	0.9930	(86)
MIT	18.7958	19.0318	19.4552	20.0165	20.4957	20.8127	20.9340	20.9066	20.6347	19.9898	19.2954	18.7627	(87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511	(88)
util rest of house	0.9898	0.9814	0.9598	0.9027	0.7892	0.6127	0.4392	0.5014	0.7697	0.9417	0.9831	0.9916	(89)
MIT 2	17.9177	18.1543	18.5752	19.1317	19.5815	19.8609	19.9456	19.9332	19.7225	19.1169	18.4274	17.8924	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.1888	18.4252	18.8469	19.4049	19.8638	20.1548	20.2508	20.2337	20.0042	19.3864	18.6954	18.1611	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1888	18.4252	18.8469	19.4049	19.8638	20.1548	20.2508	20.2337	20.0042	19.3864	18.6954	18.1611	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9753	0.9503	0.8913	0.7849	0.6272	0.4704	0.5307	0.7719	0.9322	0.9777	0.9882	(94)
Useful gains	514.6955	608.6368	710.8897	792.9529	774.4962	615.4949	439.2230	448.7320	567.9361	561.7170	502.3943	484.2710	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1834.7925	1781.4802	1621.5541	1360.7617	1054.7560	708.9815	465.9631	488.2037	757.1326	1135.1930	1506.0039	1823.1920	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	982.1522	788.1508	677.5343	408.8223	208.5133	0.0000	0.0000	0.0000	0.0000	426.6661	722.5989	996.1572	(98)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating 5210.5952 (98)
Space heating per m2 (98) / (4) = 46.3329 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1199.7626	944.4940	967.8179	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7776	0.8422	0.8065	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	932.8798	795.4853	780.5216	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1251.4879	1193.9056	1094.1190	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	229.3979	296.4247	233.3165	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												759.1391	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	57.3495	74.1062	58.3291	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												189.7848	(107)
Space cooling per m2												1.6876	(108)
Energy for space heating												46.3329	(99)
Energy for space cooling												1.6876	(108)
Total												48.0205	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

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

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9995	0.9987	0.9954	0.9796	0.9215	0.7784	0.6092	0.6812	0.9156	0.9919	0.9989	0.9996	(86)
MIT	19.6483	19.7905	20.0516	20.4121	20.7306	20.9278	20.9841	20.9725	20.8112	20.3897	19.9584	19.6308	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9993	0.9982	0.9936	0.9711	0.8875	0.6922	0.4832	0.5549	0.8643	0.9874	0.9984	0.9995	(89)
MIT 2	18.7343	18.8786	19.1411	19.5071	19.8076	19.9745	20.0053	20.0032	19.8901	19.4904	19.0571	18.7256	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(93)

8. Space heating requirement

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

8c. Space cooling requirement

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.8711	128.2372	128.2372	127.3445	127.3445	126.2623	126.5213	126.0111	126.2623	126.7879	126.7879	127.6343	(39)
Average = Sum(39)m / 12 =												127.1918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1403	1.1403	1.1324	1.1324	1.1227	1.1250	1.1205	1.1227	1.1274	1.1274	1.1349	(40)
HLP (average)												1.1310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	11.9814	0.4600	0.0000	0.7700	9.1667	(74)
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	123.1192	216.7324	353.8585	536.0173	645.1173	709.5899	667.0624	581.9215	447.3179	274.8237	157.2388	100.3100	(83)
Total gains	791.8816	880.1181	990.8225	1132.0624	1199.0078	1226.1582	1162.1842	1086.6705	975.9631	844.6197	772.6263	750.4352	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1940	33.3581	33.3581	33.5919	33.5919	33.8798	33.8105	33.9474	33.8798	33.7394	33.7394	33.5156	
alpha	3.2129	3.2239	3.2239	3.2395	3.2395	3.2587	3.2540	3.2632	3.2587	3.2493	3.2493	3.2344	
util living area	0.9705	0.9577	0.9232	0.8410	0.6986	0.4844	0.3309	0.3618	0.6462	0.8762	0.9528	0.9744	(86)
MIT	19.3337	19.5245	19.9190	20.3971	20.7634	20.9510	20.9900	20.9867	20.8669	20.4090	19.8068	19.3054	(87)
Th 2	19.9635	19.9681	19.9681	19.9745	19.9745	19.9823	19.9804	19.9841	19.9823	19.9785	19.9785	19.9724	(88)
util rest of house	0.9648	0.9495	0.9079	0.8095	0.6398	0.3965	0.2251	0.2511	0.5620	0.8438	0.9421	0.9693	(89)
MIT 2	17.7688	18.0460	18.6087	19.2732	19.7430	19.9504	19.9773	19.9797	19.8762	19.3086	18.4632	17.7339	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2519	18.5025	19.0132	19.6202	20.0580	20.2593	20.2900	20.2906	20.1820	19.6483	18.8780	18.2191	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1019	18.3525	18.8632	19.4702	19.9080	20.1093	20.1400	20.1406	20.0320	19.4983	18.7280	18.0691	(93)

8. Space heating requirement

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

Utilisation	0.9504	0.9324	0.8873	0.7915	0.6357	0.4080	0.2420	0.2686	0.5665	0.8252	0.9244	0.9561 (94)
Useful gains	752.6306	820.6200	879.1863	896.0096	762.1606	500.2209	281.2265	291.8771	552.8874	696.9499	714.2193	717.5255 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1675.5744	1635.3409	1470.0109	1218.7118	879.6948	518.8541	283.4031	294.9372	610.1050	1001.4111	1360.1810	1655.2964 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	686.6702	547.4924	439.5735	232.3456	87.4455	0.0000	0.0000	0.0000	0.0000	226.5192	465.0924	697.7015 (98)
Space heating												3382.8404 (98)
RHI space heating demand												3383 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3812	32.4772	32.5718	33.0237	33.1096	33.5156	33.5156	33.5919	33.3581	33.1096	32.9362	32.7569	
alpha	3.1587	3.1651	3.1715	3.2016	3.2073	3.2344	3.2344	3.2395	3.2239	3.2073	3.1957	3.1838	
util living area	0.9757	0.9634	0.9359	0.8732	0.7651	0.6124	0.4733	0.5227	0.7407	0.9082	0.9638	0.9790	(86)
MIT	19.1310	19.3495	19.7323	20.2254	20.6243	20.8720	20.9585	20.9425	20.7519	20.2229	19.5954	19.0951	(87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511	(88)
util rest of house	0.9711	0.9565	0.9235	0.8481	0.7184	0.5366	0.3736	0.4215	0.6737	0.8846	0.9557	0.9750	(89)
MIT 2	17.4607	17.7777	18.3281	19.0279	19.5603	19.8656	19.9490	19.9395	19.7374	19.0416	18.1452	17.4154	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.9764	18.2630	18.7616	19.3976	19.8888	20.1763	20.2607	20.2491	20.0506	19.4063	18.5929	17.9340	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8264	18.1130	18.6116	19.2476	19.7388	20.0263	20.1107	20.0991	19.9006	19.2563	18.4429	17.7840	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9580	0.9401	0.9032	0.8276	0.7072	0.5409	0.3876	0.4345	0.6687	0.8643	0.9396	0.9631	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	744.4153	822.8273	891.7701	920.5399	843.5021	634.8597	433.8830	450.3642	627.0385	709.9160	705.0876	711.9924	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1786.9155	1740.3532	1590.6510	1340.3840	1038.6111	692.5872	448.0811	471.0637	743.8531	1118.3898	1473.2178	1773.9470	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	775.6201	616.5774	519.9675	302.2878	145.1611	0.0000	0.0000	0.0000	0.0000	303.9045	553.0537	790.0942	(98)
Space heating												4006.6663	(98)
Space heating per m2											(98) / (4) =	35.6275	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4427.2556	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	775.6201	616.5774	519.9675	302.2878	145.1611	0.0000	0.0000	0.0000	0.0000	303.9045	553.0537	790.0942	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	857.0388	681.3010	574.5497	334.0197	160.3990	0.0000	0.0000	0.0000	0.0000	335.8061	611.1091	873.0322	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8807	89.8303	89.7138	89.4434	88.9064	87.3000	87.3000	87.3000	87.3000	89.4207	89.7576	89.9044	(217)
Fuel for water heating, kWh/month	199.7519	175.2407	182.1095	160.7205	156.2380	138.9421	130.3772	147.2980	148.3736	166.8504	179.5487	193.8810	(219)
Water heating fuel used												1979.3316	(219)
Annual totals kWh/year													
Space heating fuel - main system												4427.2556	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6942.1894	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4427.2556	3.4800	154.0685	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3316	3.4800	68.8807	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Total energy cost			413.5952	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1032	(257)
SAP value		84.6104	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4427.2556	0.2160	956.2872	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3316	0.2160	427.5356	(264)
Space and water heating			1383.8228	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1661.8004	(272)
CO2 emissions per m2			14.7800	(273)
EI value			85.8579	
EI rating			86	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

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

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.8711	128.2372	128.2372	127.3445	127.3445	126.2623	126.5213	126.0111	126.2623	126.7879	126.7879	127.6343	(39)
Average = Sum(39)m / 12 =												127.1918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1403	1.1403	1.1324	1.1324	1.1227	1.1250	1.1205	1.1227	1.1274	1.1274	1.1349	(40)
HLP (average)												1.1310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	11.9814	0.4600	0.0000	0.7700	9.1667	(74)
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	123.1192	216.7324	353.8585	536.0173	645.1173	709.5899	667.0624	581.9215	447.3179	274.8237	157.2388	100.3100	(83)
Total gains	791.8816	880.1181	990.8225	1132.0624	1199.0078	1226.1582	1162.1842	1086.6705	975.9631	844.6197	772.6263	750.4352	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1940	33.3581	33.3581	33.5919	33.5919	33.8798	33.8105	33.9474	33.8798	33.7394	33.7394	33.5156	
alpha	3.2129	3.2239	3.2239	3.2395	3.2395	3.2587	3.2540	3.2632	3.2587	3.2493	3.2493	3.2344	
util living area	0.9705	0.9577	0.9232	0.8410	0.6986	0.4844	0.3309	0.3618	0.6462	0.8762	0.9528	0.9744	(86)
MIT	19.3337	19.5245	19.9190	20.3971	20.7634	20.9510	20.9900	20.9867	20.8669	20.4090	19.8068	19.3054	(87)
Th 2	19.9635	19.9681	19.9681	19.9745	19.9745	19.9823	19.9804	19.9841	19.9823	19.9785	19.9785	19.9724	(88)
util rest of house	0.9648	0.9495	0.9079	0.8095	0.6398	0.3965	0.2251	0.2511	0.5620	0.8438	0.9421	0.9693	(89)
MIT 2	17.7688	18.0460	18.6087	19.2732	19.7430	19.9504	19.9773	19.9797	19.8762	19.3086	18.4632	17.7339	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2519	18.5025	19.0132	19.6202	20.0580	20.2593	20.2900	20.2906	20.1820	19.6483	18.8780	18.2191	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1019	18.3525	18.8632	19.4702	19.9080	20.1093	20.1400	20.1406	20.0320	19.4983	18.7280	18.0691	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9504	0.9324	0.8873	0.7915	0.6357	0.4080	0.2420	0.2686	0.5665	0.8252	0.9244	0.9561	(94)

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

Useful gains	752.6306	820.6200	879.1863	896.0096	762.1606	500.2209	281.2265	291.8771	552.8874	696.9499	714.2193	717.5255	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1675.5744	1635.3409	1470.0109	1218.7118	879.6948	518.8541	283.4031	294.9372	610.1050	1001.4111	1360.1810	1655.2964	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	686.6702	547.4924	439.5735	232.3456	87.4455	0.0000	0.0000	0.0000	0.0000	226.5192	465.0924	697.7015	(98)
Space heating												3382.8404	(98)
Space heating per m2											(98) / (4) =	30.0804	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3737.9452	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	686.6702	547.4924	439.5735	232.3456	87.4455	0.0000	0.0000	0.0000	0.0000	226.5192	465.0924	697.7015	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	758.7516	604.9640	485.7166	256.7355	96.6248	0.0000	0.0000	0.0000	0.0000	250.2974	513.9143	770.9409	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8176	89.7652	89.6100	89.2496	88.5090	87.3000	87.3000	87.3000	87.3000	89.2016	89.6543	89.8417	(217)
Fuel for water heating, kWh/month	199.8923	175.3678	182.3205	161.0694	156.9395	138.9421	130.3772	147.2980	148.3736	167.2602	179.7555	194.0162	(219)
Water heating fuel used												1981.6124	(219)
Annual totals kWh/year													
Space heating fuel - main system												3737.9452	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6255.1598	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3737.9452	3.9200	146.5275	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.6124	3.9200	77.6792	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Total energy cost			403.0448	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3737.9452	0.2160	807.3962	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.6124	0.2160	428.0283	(264)
Space and water heating			1235.4244	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1513.4020	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3737.9452	1.2200	4560.2931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.6124	1.2200	2417.5671	(264)
Space and water heating			6977.8602	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Primary energy kWh/year			8622.1590	(272)
Primary energy kWh/m2/year			76.6687	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 31	-192 kg (12.7%)
U Solar photovoltaic panels	+ 8.5	-£ 309	-947 kg (71.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.71 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	8.42 kg/m²	A 94	A 95
Total Savings	£340	10.12 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£91	£99	-£8
Mains gas	£312	£273	£40
Space heating	£247	£247	£0
Water heating	£78	£47	£31
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£403	£63	£341
Total cost of uses	£403	£63	£340
Delivered energy	56 kWh/m²	31 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	17 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3812	32.4772	32.5718	33.0237	33.1096	33.5156	33.5156	33.5919	33.3581	33.1096	32.9362	32.7569	
alpha	3.1587	3.1651	3.1715	3.2016	3.2073	3.2344	3.2344	3.2395	3.2239	3.2073	3.1957	3.1838	
util living area	0.9757	0.9634	0.9359	0.8732	0.7651	0.6124	0.4733	0.5227	0.7407	0.9082	0.9638	0.9790	(86)

MIT	19.1310	19.3495	19.7323	20.2254	20.6243	20.8720	20.9585	20.9425	20.7519	20.2229	19.5954	19.0951 (87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511 (88)
util rest of house	0.9711	0.9565	0.9235	0.8481	0.7184	0.5366	0.3736	0.4215	0.6737	0.8846	0.9557	0.9750 (89)
MIT 2	17.4607	17.7777	18.3281	19.0279	19.5603	19.8656	19.9490	19.9395	19.7374	19.0416	18.1452	17.4154 (90)
Living area fraction										fLA = Living area / (4) =		0.3087 (91)
MIT	17.9764	18.2630	18.7616	19.3976	19.8888	20.1763	20.2607	20.2491	20.0506	19.4063	18.5929	17.9340 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8264	18.1130	18.6116	19.2476	19.7388	20.0263	20.1107	20.0991	19.9006	19.2563	18.4429	17.7840 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9580	0.9401	0.9032	0.8276	0.7072	0.5409	0.3876	0.4345	0.6687	0.8643	0.9396	0.9631	(94)
Useful gains	744.4153	822.8273	891.7701	920.5399	843.5021	634.8597	433.8830	450.3642	627.0385	709.9160	705.0876	711.9924	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1786.9155	1740.3532	1590.6510	1340.3840	1038.6111	692.5872	448.0811	471.0637	743.8531	1118.3898	1473.2178	1773.9470	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	775.6201	616.5774	519.9675	302.2878	145.1611	0.0000	0.0000	0.0000	0.0000	303.9045	553.0537	790.0942	(98)
Space heating												4006.6663	(98)
Space heating per m2											(98) / (4) =	35.6275	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4427.2556	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	775.6201	616.5774	519.9675	302.2878	145.1611	0.0000	0.0000	0.0000	0.0000	303.9045	553.0537	790.0942	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	857.0388	681.3010	574.5497	334.0197	160.3990	0.0000	0.0000	0.0000	0.0000	335.8061	611.1091	873.0322	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9534	89.9815	90.0080	90.0564	90.1127	87.3000	87.3000	87.3000	87.3000	89.7170	89.8691	89.9649	(217)
Fuel for water heating, kWh/month	171.3285	127.7997	101.2420	52.1037	21.3943	4.2204	0.0000	31.1465	57.4037	105.8512	145.7716	170.1031	(219)
Water heating fuel used												988.3646	(219)
Annual totals kWh/year													
Space heating fuel - main system												4427.2556	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4273.9830	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4427.2556	3.4800	154.0685	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.3646	3.4800	34.3951	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			157.8816	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4211	(257)
SAP value		94.1253	
SAP rating (Section 12)		94	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4427.2556	0.2160	956.2872	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.3646	0.2160	213.4867	(264)
Space and water heating			1169.7740	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			577.2643	(272)
CO2 emissions per m2			5.1300	(273)
EI value			95.0874	
EI rating			95	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.8711	128.2372	128.2372	127.3445	127.3445	126.2623	126.5213	126.0111	126.2623	126.7879	126.7879	127.6343	(39)
Average = Sum(39)m / 12 =												127.1918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1403	1.1403	1.1324	1.1324	1.1227	1.1250	1.1205	1.1227	1.1274	1.1274	1.1349	(40)
HLP (average)												1.1310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2007	(H8)
Utilisation factor												0.5652	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-894.4782	(H17)
Solar input	-27.5316	-41.3799	-69.6890	-96.3316	-116.0156	-122.1014	-119.1695	-106.4191	-83.0605	-56.5045	-33.4654	-22.8101	(63)
								Solar input (sum of months) = Sum(63)m =				-894.4782	(63)
Output from w/h	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
								Total per year (kWh/year) = Sum(64)m =				872.5734	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	11.9814	0.4600	0.0000	0.7700	9.1667	(74)
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	123.1192	216.7324	353.8585	536.0173	645.1173	709.5899	667.0624	581.9215	447.3179	274.8237	157.2388	100.3100	(83)
Total gains	791.8816	880.1181	990.8225	1132.0624	1199.0078	1226.1582	1162.1842	1086.6705	975.9631	844.6197	772.6263	750.4352	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1940	33.3581	33.3581	33.5919	33.5919	33.8798	33.8105	33.9474	33.8798	33.7394	33.7394	33.5156	
alpha	3.2129	3.2239	3.2239	3.2395	3.2395	3.2587	3.2540	3.2632	3.2587	3.2493	3.2493	3.2344	
util living area	0.9705	0.9577	0.9232	0.8410	0.6986	0.4844	0.3309	0.3618	0.6462	0.8762	0.9528	0.9744	(86)

MIT	19.3337	19.5245	19.9190	20.3971	20.7634	20.9510	20.9900	20.9867	20.8669	20.4090	19.8068	19.3054 (87)
Th 2	19.9635	19.9681	19.9681	19.9745	19.9745	19.9823	19.9804	19.9841	19.9823	19.9785	19.9785	19.9724 (88)
util rest of house	0.9648	0.9495	0.9079	0.8095	0.6398	0.3965	0.2251	0.2511	0.5620	0.8438	0.9421	0.9693 (89)
MIT 2	17.7688	18.0460	18.6087	19.2732	19.7430	19.9504	19.9773	19.9797	19.8762	19.3086	18.4632	17.7339 (90)
Living area fraction										fLA = Living area / (4) =		0.3087 (91)
MIT	18.2519	18.5025	19.0132	19.6202	20.0580	20.2593	20.2900	20.2906	20.1820	19.6483	18.8780	18.2191 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1019	18.3525	18.8632	19.4702	19.9080	20.1093	20.1400	20.1406	20.0320	19.4983	18.7280	18.0691 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9504	0.9324	0.8873	0.7915	0.6357	0.4080	0.2420	0.2686	0.5665	0.8252	0.9244	0.9561	(94)
Useful gains	752.6306	820.6200	879.1863	896.0096	762.1606	500.2209	281.2265	291.8771	552.8874	696.9499	714.2193	717.5255	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1675.5744	1635.3409	1470.0109	1218.7118	879.6948	518.8541	283.4031	294.9372	610.1050	1001.4111	1360.1810	1655.2964	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	686.6702	547.4924	439.5735	232.3456	87.4455	0.0000	0.0000	0.0000	0.0000	226.5192	465.0924	697.7015	(98)
Space heating												3382.8404	(98)
Space heating per m2											(98) / (4) =	30.0804	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3737.9452	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	686.6702	547.4924	439.5735	232.3456	87.4455	0.0000	0.0000	0.0000	0.0000	226.5192	465.0924	697.7015	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	758.7516	604.9640	485.7166	256.7355	96.6248	0.0000	0.0000	0.0000	0.0000	250.2974	513.9143	770.9409	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9027	89.9236	89.9209	89.9412	89.8170	87.3000	87.3000	87.3000	87.3000	89.5469	89.7910	89.9120	(217)
Fuel for water heating, kWh/month	169.0793	129.0421	104.1896	52.7258	25.4852	0.0000	0.0000	25.3976	53.2299	103.5149	142.2116	168.4951	(219)
Water heating fuel used												973.3711	(219)
Annual totals kWh/year													
Space heating fuel - main system												3737.9452	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3472.7589	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3737.9452	3.9200	146.5275	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.3711	3.9200	38.1561	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			62.6243	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3737.9452	0.2160	807.3962	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.3711	0.2160	210.2482	(264)
Space and water heating			1017.6443	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			374.8330	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3737.9452	1.2200	4560.2931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.3711	1.2200	1187.5128	(264)
Space and water heating			5747.8059	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1945.4346	(272)
Primary energy kWh/m2/year			17.2989	(273)

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

Overheating Calculation Input Data

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

Overheating Calculation

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

Overhangs

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

Solar shading

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

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

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

Assessment of likelihood of high internal temperature:	Slight

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-304	**Issued on Date**	19/10/2022
Assessment Reference	Plot 304	**Prop Type Ref**	Ebbertson-Opp-SEMI
Property	Plot 304, 3 Bed, K, WC, B, Es		

SAP Rating	85 B	**DER**	15.96	**TER**	17.18
Environmental	86 B	**% DER<TER**	7.11		
CO_2 Emissions (t/year)	1.49	**DFEE**	46.89	**TFEE**	53.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.06		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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

Semi-Detached House, total floor area 112 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.18 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.96 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.9 kWh/m²/yrOK

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2 Fabric U-values

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

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

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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

Secondary heating system: None

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

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

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

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3812	32.4772	32.5718	33.0237	33.1096	33.5156	33.5156	33.5919	33.3581	33.1096	32.9362	32.7569	
alpha	3.1587	3.1651	3.1715	3.2016	3.2073	3.2344	3.2344	3.2395	3.2239	3.2073	3.1957	3.1838	
util living area	0.9889	0.9797	0.9584	0.9073	0.8124	0.6689	0.5271	0.5802	0.7963	0.9417	0.9819	0.9909	(86)
MIT	18.8980	19.1470	19.5635	20.0966	20.5419	20.8334	20.9433	20.9220	20.6863	20.0816	19.3941	18.8606	(87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511	(88)
util rest of house	0.9867	0.9756	0.9498	0.8872	0.7702	0.5929	0.4203	0.4737	0.7349	0.9251	0.9776	0.9891	(89)
MIT 2	17.1238	17.4871	18.0906	18.8554	19.4617	19.8294	19.9394	19.9253	19.6665	18.8502	17.8571	17.0757	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6715	17.9995	18.5454	19.2386	19.7952	20.1394	20.2494	20.2330	19.9813	19.2303	18.3316	17.6268	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5215	17.8495	18.3954	19.0886	19.6452	19.9894	20.0994	20.0830	19.8313	19.0803	18.1816	17.4768	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9789	0.9638	0.9325	0.8663	0.7554	0.5943	0.4343	0.4859	0.7254	0.9061	0.9668	0.9824	(94)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful gains	571.8250	675.3471	772.1241	832.5208	789.5820	612.3411	426.9439	440.5033	586.8469	613.2354	559.3289	538.1030	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1746.6431	1705.6570	1562.2521	1319.7855	1026.5194	687.8717	446.6372	469.0109	734.9699	1095.6569	1439.2771	1733.8231	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	874.0646	692.3682	587.8552	350.8306	176.2815	0.0000	0.0000	0.0000	0.0000	358.9216	633.5627	889.6157	(98)
Space heating												4563.5002	(98)
Space heating per m2											(98) / (4) =	40.5789	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5042.5416	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	874.0646	692.3682	587.8552	350.8306	176.2815	0.0000	0.0000	0.0000	0.0000	358.9216	633.5627	889.6157	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	965.8173	765.0478	649.5638	387.6581	194.7862	0.0000	0.0000	0.0000	0.0000	396.5984	700.0693	983.0008	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9382	89.8896	89.7843	89.5460	89.0613	87.3000	87.3000	87.3000	87.3000	89.5363	89.8323	89.9598	(217)
Fuel for water heating, kWh/month	199.6242	175.1250	181.9665	160.5363	155.9664	138.9421	130.3772	147.2980	148.3736	166.6349	179.3995	193.7617	(219)
Water heating fuel used												1978.0054	(219)
Annual totals kWh/year													
Space heating fuel - main system												5042.5416	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												7556.1493	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5042.5416	0.2160	1089.1890	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.0054	0.2160	427.2492	(264)
Space and water heating			1516.4382	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/year			1794.4157	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9600	(273)

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

DER		15.9600	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		32.1146	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.1146	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

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

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

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

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

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9990	0.9976	0.9923	0.9707	0.9015	0.7478	0.5759	0.6367	0.8811	0.9857	0.9979	0.9993	(86)
MIT	19.7073	19.8595	20.1212	20.4695	20.7655	20.9404	20.9877	20.9798	20.8502	20.4535	20.0189	19.6867	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9987	0.9967	0.9895	0.9590	0.8621	0.6597	0.4545	0.5138	0.8188	0.9781	0.9970	0.9991	(89)
MIT 2	18.2430	18.4675	18.8507	19.3597	19.7608	19.9684	20.0048	20.0030	19.8784	19.3450	18.7105	18.2208	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6951	18.8973	19.2429	19.7023	20.0710	20.2685	20.3083	20.3045	20.1784	19.6872	19.1145	18.6734	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6951	18.8973	19.2429	19.7023	20.0710	20.2685	20.3083	20.3045	20.1784	19.6872	19.1145	18.6734	(93)

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8. Space heating requirement

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5098.7329	(211)

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

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

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

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

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

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

Metabolic gains (Table 5), Watts

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8392	31.9336	32.0266	32.4709	32.5554	32.9547	32.9547	33.0297	32.7997	32.5554	32.3849	32.2086	
alpha	3.1226	3.1289	3.1351	3.1647	3.1704	3.1970	3.1970	3.2020	3.1866	3.1704	3.1590	3.1472	
util living area	0.9902	0.9815	0.9611	0.9117	0.8192	0.6779	0.5364	0.5916	0.8059	0.9463	0.9839	0.9920	(86)
MIT	18.8306	19.0845	19.5102	20.0565	20.5160	20.8208	20.9379	20.9143	20.6642	20.0384	19.3355	18.7934	(87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511	(88)
util rest of house	0.9882	0.9778	0.9531	0.8925	0.7781	0.6025	0.4289	0.4848	0.7464	0.9308	0.9801	0.9904	(89)
MIT 2	17.9523	18.2063	18.6287	19.1690	19.5986	19.8663	19.9474	19.9370	19.7454	19.1630	18.4670	17.9229	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2234	18.4774	18.9008	19.4430	19.8818	20.1610	20.2532	20.2387	20.0291	19.4332	18.7351	18.1917	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2234	18.4774	18.9008	19.4430	19.8818	20.1610	20.2532	20.2387	20.0291	19.4332	18.7351	18.1917	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9837	0.9708	0.9428	0.8811	0.7745	0.6175	0.4599	0.5142	0.7504	0.9209	0.9740	0.9866	(94)
Useful gains	540.8130	647.6482	750.7038	820.8333	788.0478	620.3842	441.1852	452.7513	586.7321	596.0542	532.0047	507.2889	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1839.3693	1788.3574	1628.6366	1365.6943	1057.0883	709.7711	466.2724	488.8404	760.3256	1141.2517	1511.1657	1827.1858	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	966.1259	766.5566	653.1820	392.2999	200.1661	0.0000	0.0000	0.0000	0.0000	405.6270	704.9959	982.0033	(98)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating 5070.9567 (98)
Space heating per m2 (98) / (4) = 45.0912 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1199.7626	944.4940	967.8179	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7854	0.8496	0.8188	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	942.3466	802.4245	792.4432	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1278.8180	1223.7154	1134.9394	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	242.2594	313.4404	254.8172	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												810.5170	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	60.5649	78.3601	63.7043	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												202.6293	(107)
Space cooling per m2												1.8018	(108)
Energy for space heating												45.0912	(99)
Energy for space cooling												1.8018	(108)
Total												46.8930	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

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

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

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

8. Space heating requirement

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

8c. Space cooling requirement

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.8711	128.2372	128.2372	127.3445	127.3445	126.2623	126.5213	126.0111	126.2623	126.7879	126.7879	127.6343	(39)
Average = Sum(39)m / 12 =												127.1918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1403	1.1403	1.1324	1.1324	1.1227	1.1250	1.1205	1.1227	1.1274	1.1274	1.1349	(40)
HLP (average)												1.1310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

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

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

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

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
South	2.1600	50.9848	0.4600	0.0000	0.7700	39.0071	(78)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	152.9596	258.1605	398.9120	575.3596	672.4073	731.3781	690.7956	616.1175	493.6801	320.4811	192.9525	126.1701	(83)
Total gains	821.7220	921.5461	1035.8760	1171.4047	1226.2978	1247.9463	1185.9173	1120.8665	1022.3253	890.2772	808.3400	776.2953	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1940	33.3581	33.3581	33.5919	33.5919	33.8798	33.8105	33.9474	33.8798	33.7394	33.7394	33.5156	
alpha	3.2129	3.2239	3.2239	3.2395	3.2395	3.2587	3.2540	3.2632	3.2587	3.2493	3.2493	3.2344	
util living area	0.9675	0.9524	0.9149	0.8303	0.6891	0.4772	0.3246	0.3515	0.6260	0.8620	0.9471	0.9719	(86)
MIT	19.3681	19.5699	19.9620	20.4240	20.7731	20.9531	20.9905	20.9878	20.8790	20.4448	19.8453	19.3358	(87)
Th 2	19.9635	19.9681	19.9681	19.9745	19.9745	19.9823	19.9804	19.9841	19.9823	19.9785	19.9785	19.9724	(88)
util rest of house	0.9613	0.9434	0.8984	0.7976	0.6300	0.3902	0.2207	0.2436	0.5420	0.8272	0.9353	0.9665	(89)
MIT 2	17.8181	18.1103	18.6678	19.3075	19.7534	19.9519	19.9775	19.9800	19.8869	19.3542	18.5172	17.7775	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2967	18.5610	19.0674	19.6522	20.0682	20.2610	20.2903	20.2912	20.1932	19.6909	18.9272	18.2586	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1467	18.4110	18.9174	19.5022	19.9182	20.1110	20.1403	20.1412	20.0432	19.5409	18.7772	18.1086	(93)

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8. Space heating requirement

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

Utilisation	0.9461	0.9254	0.8774	0.7803	0.6265	0.4017	0.2373	0.2607	0.5474	0.8094	0.9169	0.9526	(94)
Useful gains	777.4438	852.8213	908.9227	913.9903	768.2735	501.2518	281.3886	292.2146	559.6566	720.5481	741.1556	739.4714	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1681.3379	1642.8425	1476.9582	1222.7861	880.9947	519.0633	283.4405	295.0133	611.5142	1006.8113	1366.4183	1660.3455	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	672.4972	530.8943	422.6184	222.3330	83.8646	0.0000	0.0000	0.0000	0.0000	212.9798	450.1891	685.1303	(98)
Space heating												3280.5068	(98)
RHI space heating demand												3281	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3812	32.4772	32.5718	33.0237	33.1096	33.5156	33.5156	33.5919	33.3581	33.1096	32.9362	32.7569	
alpha	3.1587	3.1651	3.1715	3.2016	3.2073	3.2344	3.2344	3.2395	3.2239	3.2073	3.1957	3.1838	
util living area	0.9733	0.9586	0.9283	0.8632	0.7554	0.6038	0.4642	0.5087	0.7213	0.8968	0.9596	0.9771	(86)
MIT	19.1633	19.3974	19.7804	20.2581	20.6394	20.8773	20.9608	20.9468	20.7717	20.2628	19.6316	19.1238	(87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511	(88)
util rest of house	0.9683	0.9510	0.9147	0.8369	0.7079	0.5282	0.3659	0.4091	0.6530	0.8711	0.9508	0.9728	(89)
MIT 2	17.5072	17.8460	18.3951	19.0709	19.5780	19.8704	19.9504	19.9424	19.7580	19.0946	18.1967	17.4568	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.0185	18.3250	18.8228	19.4374	19.9057	20.1813	20.2623	20.2525	20.0710	19.4553	18.6397	17.9715	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8685	18.1750	18.6728	19.2874	19.7557	20.0313	20.1123	20.1025	19.9210	19.3053	18.4897	17.8215	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9545	0.9336	0.8938	0.8168	0.6975	0.5328	0.3798	0.4222	0.6496	0.8509	0.9338	0.9602	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	768.0719	857.3011	925.5777	942.7506	853.3635	637.8974	434.8974	452.4216	639.0526	736.9181	730.9643	733.0226	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1792.4829	1748.5174	1598.6902	1345.5457	1040.7928	693.2160	448.2915	471.4895	746.4642	1124.7179	1479.2883	1778.8418	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	762.1618	598.8974	500.7957	290.0125	139.4474	0.0000	0.0000	0.0000	0.0000	288.5230	538.7933	778.0895	(98)
Space heating												3896.7206	(98)
Space heating per m2											(98) / (4) =	34.6498	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4305.7686	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	762.1618	598.8974	500.7957	290.0125	139.4474	0.0000	0.0000	0.0000	0.0000	288.5230	538.7933	778.0895	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	842.1677	661.7651	553.3655	320.4558	154.0855	0.0000	0.0000	0.0000	0.0000	318.8100	595.3517	859.7674	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8719	89.8148	89.6913	89.4138	88.8743	87.3000	87.3000	87.3000	87.3000	89.3832	89.7426	89.8969	(217)
Fuel for water heating, kWh/month	199.7715	175.2710	182.1552	160.7736	156.2945	138.9421	130.3772	147.2980	148.3736	166.9203	179.5787	193.8971	(219)
Water heating fuel used												1979.6527	(219)
Annual totals kWh/year													
Space heating fuel - main system												4305.7686	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6821.0236	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4305.7686	3.4800	149.8407	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.6527	3.4800	68.8919	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Total energy cost			409.3786	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0920	(257)
SAP value		84.7672	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4305.7686	0.2160	930.0460	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.6527	0.2160	427.6050	(264)
Space and water heating			1357.6510	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1635.6286	(272)
CO2 emissions per m2			14.5400	(273)
EI value			86.0806	
EI rating			86	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

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

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.8711	128.2372	128.2372	127.3445	127.3445	126.2623	126.5213	126.0111	126.2623	126.7879	126.7879	127.6343	(39)
Average = Sum(39)m / 12 =												127.1918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1403	1.1403	1.1324	1.1324	1.1227	1.1250	1.1205	1.1227	1.1274	1.1274	1.1349	(40)
HLP (average)												1.1310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
South	2.1600	50.9848	0.4600	0.0000	0.7700	39.0071	(78)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	152.9596	258.1605	398.9120	575.3596	672.4073	731.3781	690.7956	616.1175	493.6801	320.4811	192.9525	126.1701	(83)
Total gains	821.7220	921.5461	1035.8760	1171.4047	1226.2978	1247.9463	1185.9173	1120.8665	1022.3253	890.2772	808.3400	776.2953	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1940	33.3581	33.3581	33.5919	33.5919	33.8798	33.8105	33.9474	33.8798	33.7394	33.7394	33.5156	
alpha	3.2129	3.2239	3.2239	3.2395	3.2395	3.2587	3.2540	3.2632	3.2587	3.2493	3.2493	3.2344	
util living area	0.9675	0.9524	0.9149	0.8303	0.6891	0.4772	0.3246	0.3515	0.6260	0.8620	0.9471	0.9719	(86)
MIT	19.3681	19.5699	19.9620	20.4240	20.7731	20.9531	20.9905	20.9878	20.8790	20.4448	19.8453	19.3358	(87)
Th 2	19.9635	19.9681	19.9681	19.9745	19.9745	19.9823	19.9804	19.9841	19.9823	19.9785	19.9785	19.9724	(88)
util rest of house	0.9613	0.9434	0.8984	0.7976	0.6300	0.3902	0.2207	0.2436	0.5420	0.8272	0.9353	0.9665	(89)
MIT 2	17.8181	18.1103	18.6678	19.3075	19.7534	19.9519	19.9775	19.9800	19.8869	19.3542	18.5172	17.7775	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2967	18.5610	19.0674	19.6522	20.0682	20.2610	20.2903	20.2912	20.1932	19.6909	18.9272	18.2586	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1467	18.4110	18.9174	19.5022	19.9182	20.1110	20.1403	20.1412	20.0432	19.5409	18.7772	18.1086	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9461	0.9254	0.8774	0.7803	0.6265	0.4017	0.2373	0.2607	0.5474	0.8094	0.9169	0.9526	(94)

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

Useful gains	777.4438	852.8213	908.9227	913.9903	768.2735	501.2518	281.3886	292.2146	559.6566	720.5481	741.1556	739.4714	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1681.3379	1642.8425	1476.9582	1222.7861	880.9947	519.0633	283.4405	295.0133	611.5142	1006.8113	1366.4183	1660.3455	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	672.4972	530.8943	422.6184	222.3330	83.8646	0.0000	0.0000	0.0000	0.0000	212.9798	450.1891	685.1303	(98)
Space heating												3280.5068	(98)
Space heating per m2											(98) / (4) =	29.1704	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3624.8694	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	672.4972	530.8943	422.6184	222.3330	83.8646	0.0000	0.0000	0.0000	0.0000	212.9798	450.1891	685.1303	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	743.0909	586.6235	466.9817	245.6718	92.6681	0.0000	0.0000	0.0000	0.0000	235.3368	497.4465	757.0501	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8063	89.7476	89.5845	89.2159	88.4778	87.3000	87.3000	87.3000	87.3000	89.1538	89.6339	89.8322	(217)
Fuel for water heating, kWh/month	199.9174	175.4021	182.3723	161.1303	156.9950	138.9421	130.3772	147.2980	148.3736	167.3499	179.7965	194.0369	(219)
Water heating fuel used												1981.9913	(219)
Annual totals kWh/year													
Space heating fuel - main system												3624.8694	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6142.4629	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3624.8694	3.9200	142.0949	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.9913	3.9200	77.6941	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Total energy cost			398.6271	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3624.8694	0.2160	782.9718	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.9913	0.2160	428.1101	(264)
Space and water heating			1211.0819	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1489.0595	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3624.8694	1.2200	4422.3406	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.9913	1.2200	2418.0294	(264)
Space and water heating			6840.3701	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Primary energy kWh/year			8484.6688	(272)
Primary energy kWh/m2/year			75.4461	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 31	-192 kg (12.9%)
U Solar photovoltaic panels	+ 8.5	-£ 309	-947 kg (73.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.71 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.42 kg/m²	A 94	A 95
Total Savings	£340	10.12 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£91	£99	-£8
Mains gas	£308	£268	£40
Space heating	£243	£243	£0
Water heating	£78	£47	£31
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£399	£58	£341
Total cost of uses	£399	£59	£340
Delivered energy	55 kWh/m²	30 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	16 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	132.1059	131.7155	131.3329	129.5358	129.1996	127.6343	127.6343	127.3445	128.2372	129.1996	129.8798	130.5909	(39)
Average = Sum(39)m / 12 =												129.5342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1712	1.1678	1.1518	1.1488	1.1349	1.1349	1.1324	1.1403	1.1488	1.1549	1.1612	(40)
HLP (average)												1.1518	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3812	32.4772	32.5718	33.0237	33.1096	33.5156	33.5156	33.5919	33.3581	33.1096	32.9362	32.7569	
alpha	3.1587	3.1651	3.1715	3.2016	3.2073	3.2344	3.2344	3.2395	3.2239	3.2073	3.1957	3.1838	
util living area	0.9733	0.9586	0.9283	0.8632	0.7554	0.6038	0.4642	0.5087	0.7213	0.8968	0.9596	0.9771	(86)

MIT	19.1633	19.3974	19.7804	20.2581	20.6394	20.8773	20.9608	20.9468	20.7717	20.2628	19.6316	19.1238 (87)
Th 2	19.9403	19.9431	19.9458	19.9587	19.9611	19.9724	19.9724	19.9745	19.9681	19.9611	19.9563	19.9511 (88)
util rest of house	0.9683	0.9510	0.9147	0.8369	0.7079	0.5282	0.3659	0.4091	0.6530	0.8711	0.9508	0.9728 (89)
MIT 2	17.5072	17.8460	18.3951	19.0709	19.5780	19.8704	19.9504	19.9424	19.7580	19.0946	18.1967	17.4568 (90)
Living area fraction										fLA = Living area / (4) =		0.3087 (91)
MIT	18.0185	18.3250	18.8228	19.4374	19.9057	20.1813	20.2623	20.2525	20.0710	19.4553	18.6397	17.9715 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8685	18.1750	18.6728	19.2874	19.7557	20.0313	20.1123	20.1025	19.9210	19.3053	18.4897	17.8215 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9545	0.9336	0.8938	0.8168	0.6975	0.5328	0.3798	0.4222	0.6496	0.8509	0.9338	0.9602	(94)
Useful gains	768.0719	857.3011	925.5777	942.7506	853.3635	637.8974	434.8974	452.4216	639.0526	736.9181	730.9643	733.0226	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1792.4829	1748.5174	1598.6902	1345.5457	1040.7928	693.2160	448.2915	471.4895	746.4642	1124.7179	1479.2883	1778.8418	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	762.1618	598.8974	500.7957	290.0125	139.4474	0.0000	0.0000	0.0000	0.0000	288.5230	538.7933	778.0895	(98)
Space heating												3896.7206	(98)
Space heating per m2											(98) / (4) =	34.6498	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4305.7686	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	762.1618	598.8974	500.7957	290.0125	139.4474	0.0000	0.0000	0.0000	0.0000	288.5230	538.7933	778.0895	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	842.1677	661.7651	553.3655	320.4558	154.0855	0.0000	0.0000	0.0000	0.0000	318.8100	595.3517	859.7674	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9455	89.9688	89.9922	90.0404	90.0989	87.3000	87.3000	87.3000	87.3000	89.6859	89.8558	89.9581	(217)
Fuel for water heating, kWh/month	171.3437	127.8178	101.2598	52.1130	21.3976	4.2204	0.0000	31.1465	57.4037	105.8879	145.7932	170.1161	(219)
Water heating fuel used												988.4997	(219)
Annual totals kWh/year													
Space heating fuel - main system												4305.7686	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4152.6311	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4305.7686	3.4800	149.8407	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.4997	3.4800	34.3998	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			153.6586	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4099	(257)
SAP value		94.2824	
SAP rating (Section 12)		94	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4305.7686	0.2160	930.0460	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.4997	0.2160	213.5159	(264)
Space and water heating			1143.5620	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			551.0523	(272)
CO2 emissions per m2			4.9000	(273)
EI value			95.3105	
EI rating			95	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3879	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.8711	128.2372	128.2372	127.3445	127.3445	126.2623	126.5213	126.0111	126.2623	126.7879	126.7879	127.6343	(39)
Average = Sum(39)m / 12 =												127.1918	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1403	1.1403	1.1324	1.1324	1.1227	1.1250	1.1205	1.1227	1.1274	1.1274	1.1349	(40)
HLP (average)												1.1310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2007	(H8)
Utilisation factor												0.5652	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-894.4782	(H17)
Solar input	-27.5316	-41.3799	-69.6890	-96.3316	-116.0156	-122.1014	-119.1695	-106.4191	-83.0605	-56.5045	-33.4654	-22.8101	(63)
								Solar input (sum of months) = Sum(63)m =				-894.4782	(63)
Output from w/h	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
								Total per year (kWh/year) = Sum(64)m =				872.5734	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
South	2.1600	50.9848	0.4600	0.0000	0.7700	39.0071	(78)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	152.9596	258.1605	398.9120	575.3596	672.4073	731.3781	690.7956	616.1175	493.6801	320.4811	192.9525	126.1701	(83)
Total gains	821.7220	921.5461	1035.8760	1171.4047	1226.2978	1247.9463	1185.9173	1120.8665	1022.3253	890.2772	808.3400	776.2953	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1940	33.3581	33.3581	33.5919	33.5919	33.8798	33.8105	33.9474	33.8798	33.7394	33.7394	33.5156	
alpha	3.2129	3.2239	3.2239	3.2395	3.2395	3.2587	3.2540	3.2632	3.2587	3.2493	3.2493	3.2344	
util living area	0.9675	0.9524	0.9149	0.8303	0.6891	0.4772	0.3246	0.3515	0.6260	0.8620	0.9471	0.9719	(86)

MIT	19.3681	19.5699	19.9620	20.4240	20.7731	20.9531	20.9905	20.9878	20.8790	20.4448	19.8453	19.3358 (87)
Th 2	19.9635	19.9681	19.9681	19.9745	19.9745	19.9823	19.9804	19.9841	19.9823	19.9785	19.9785	19.9724 (88)
util rest of house	0.9613	0.9434	0.8984	0.7976	0.6300	0.3902	0.2207	0.2436	0.5420	0.8272	0.9353	0.9665 (89)
MIT 2	17.8181	18.1103	18.6678	19.3075	19.7534	19.9519	19.9775	19.9800	19.8869	19.3542	18.5172	17.7775 (90)
Living area fraction										fLA = Living area / (4) =		0.3087 (91)
MIT	18.2967	18.5610	19.0674	19.6522	20.0682	20.2610	20.2903	20.2912	20.1932	19.6909	18.9272	18.2586 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1467	18.4110	18.9174	19.5022	19.9182	20.1110	20.1403	20.1412	20.0432	19.5409	18.7772	18.1086 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9461	0.9254	0.8774	0.7803	0.6265	0.4017	0.2373	0.2607	0.5474	0.8094	0.9169	0.9526	(94)
Useful gains	777.4438	852.8213	908.9227	913.9903	768.2735	501.2518	281.3886	292.2146	559.6566	720.5481	741.1556	739.4714	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1681.3379	1642.8425	1476.9582	1222.7861	880.9947	519.0633	283.4405	295.0133	611.5142	1006.8113	1366.4183	1660.3455	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	672.4972	530.8943	422.6184	222.3330	83.8646	0.0000	0.0000	0.0000	0.0000	212.9798	450.1891	685.1303	(98)
Space heating												3280.5068	(98)
Space heating per m2											(98) / (4) =	29.1704	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3624.8694	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	672.4972	530.8943	422.6184	222.3330	83.8646	0.0000	0.0000	0.0000	0.0000	212.9798	450.1891	685.1303	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	743.0909	586.6235	466.9817	245.6718	92.6681	0.0000	0.0000	0.0000	0.0000	235.3368	497.4465	757.0501	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8925	89.9089	89.9020	89.9206	89.7943	87.3000	87.3000	87.3000	87.3000	89.5051	89.7729	89.9033	(217)
Fuel for water heating, kWh/month	169.0985	129.0632	104.2115	52.7379	25.4916	0.0000	0.0000	25.3976	53.2299	103.5631	142.2403	168.5116	(219)
Water heating fuel used												973.5453	(219)
Annual totals kWh/year													
Space heating fuel - main system												3624.8694	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3359.8572	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3624.8694	3.9200	142.0949	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.5453	3.9200	38.1630	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			58.1985	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3624.8694	0.2160	782.9718	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.5453	0.2160	210.2858	(264)
Space and water heating			993.2576	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			350.4463	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3624.8694	1.2200	4422.3406	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.5453	1.2200	1187.7253	(264)
Space and water heating			5610.0659	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1807.6946	(272)
Primary energy kWh/m2/year			16.0741	(273)

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

Overheating Calculation Input Data

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

Overheating Calculation

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

Overhangs

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

Solar shading

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

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

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

Assessment of likelihood of high internal temperature:	Slight

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-305	**Issued on Date**	19/10/2022
Assessment Reference	Plot 305	**Prop Type Ref**	Ebbertson-As-SEMI
Property	Plot 305, 3 Bed, K, WC, B, Es		

SAP Rating	85 B	**DER**	16.21	**TER**	17.47
Environmental	86 B	**% DER<TER**	7.19		
CO_2 Emissions (t/year)	1.51	**DFEE**	47.94	**TFEE**	55.35
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.38		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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

Semi-Detached House, total floor area 112 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.47 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.21 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.9 kWh/m²/yrOK
---
2 Fabric U-values

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

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

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

Hot water controls: No cylinder

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9903	0.9829	0.9643	0.9161	0.8221	0.6783	0.5378	0.5969	0.8162	0.9507	0.9846	0.9920	(86)
MIT	18.8664	19.0979	19.5122	20.0599	20.5240	20.8267	20.9401	20.9154	20.6595	20.0362	19.3570	18.8331	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9884	0.9794	0.9567	0.8975	0.7810	0.6026	0.4299	0.4894	0.7578	0.9362	0.9809	0.9904	(89)
MIT 2	17.0786	17.4170	18.0185	18.8064	19.4409	19.8241	19.9385	19.9218	19.6376	18.7883	17.8044	17.0364	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6306	17.9359	18.4797	19.1934	19.7753	20.1336	20.2477	20.2286	19.9531	19.1735	18.2837	17.5911	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4806	17.7859	18.3297	19.0434	19.6253	19.9836	20.0977	20.0786	19.8031	19.0235	18.1337	17.4411	(93)

8. Space heating requirement

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9813	0.9689	0.9406	0.8767	0.7655	0.6034	0.4438	0.5011	0.7466	0.9182	0.9711	0.9843	(94)
Useful gains	546.1357	637.2018	733.5490	805.7875	776.6412	607.5905	424.9699	436.8049	569.4821	580.4146	530.4074	515.4192	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1739.0394	1695.1330	1551.6559	1312.2465	1022.6199	686.2349	445.8462	467.8325	730.3998	1086.9126	1431.2225	1726.9597	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	887.5204	710.9297	608.6715	364.6505	183.0081	0.0000	0.0000	0.0000	0.0000	376.8345	648.5868	901.3861	(98)
Space heating												4681.5877	(98)
Space heating per m2											(98) / (4) =	41.6289	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5173.0250	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	887.5204	710.9297	608.6715	364.6505	183.0081	0.0000	0.0000	0.0000	0.0000	376.8345	648.5868	901.3861	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	980.6855	785.5577	672.5652	402.9287	202.2189	0.0000	0.0000	0.0000	0.0000	416.3917	716.6705	996.0068	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9453	89.9026	89.8034	89.5716	89.0909	87.3000	87.3000	87.3000	87.3000	89.5688	89.8446	89.9656	(217)
Fuel for water heating, kWh/month	199.6086	175.0998	181.9277	160.4903	155.9146	138.9421	130.3772	147.2980	148.3736	166.5745	179.3749	193.7490	(219)
Water heating fuel used												1977.7303	(219)
Annual totals kWh/year													
Space heating fuel - main system												5173.0250	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												7686.3576	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5173.0250	0.2160	1117.3734	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.7303	0.2160	427.1897	(264)
Space and water heating			1544.5632	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/year			1822.5407	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.2100	(273)

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

DER		16.2100	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		32.3646	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.3646	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

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

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

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7. Mean internal temperature (heating season)

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

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

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

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8. Space heating requirement

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

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

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

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8794	31.9740	32.0673	32.5127	32.5974	32.9977	32.9977	33.0729	32.8424	32.5974	32.4265	32.2497	
alpha	3.1253	3.1316	3.1378	3.1675	3.1732	3.1998	3.1998	3.2049	3.1895	3.1732	3.1618	3.1500	
util living area	0.9915	0.9845	0.9668	0.9203	0.8288	0.6875	0.5474	0.6088	0.8259	0.9550	0.9864	0.9930	(86)
MIT	18.7985	19.0345	19.4577	20.0187	20.4972	20.8135	20.9344	20.9071	20.6359	19.9916	19.2977	18.7654	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9898	0.9814	0.9598	0.9026	0.7889	0.6124	0.4389	0.5011	0.7694	0.9417	0.9831	0.9916	(89)
MIT 2	17.9212	18.1578	18.5785	19.1347	19.5839	19.8626	19.9469	19.9346	19.7245	19.1195	18.4305	17.8960	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.1921	18.4285	18.8500	19.4076	19.8658	20.1562	20.2518	20.2348	20.0058	19.3887	18.6983	18.1644	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1921	18.4285	18.8500	19.4076	19.8658	20.1562	20.2518	20.2348	20.0058	19.3887	18.6983	18.1644	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9753	0.9503	0.8912	0.7847	0.6269	0.4700	0.5304	0.7717	0.9321	0.9777	0.9883	(94)
Useful gains	514.6997	608.6391	710.8777	792.8783	774.2908	615.1639	438.8975	448.4365	567.7791	561.6969	502.3970	484.2751	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1832.9127	1779.6555	1619.8995	1359.3605	1053.6645	708.2353	465.4875	487.7065	756.3657	1134.0389	1504.4490	1821.2980	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

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	980.7505	786.9230	676.3122	407.8672	207.8541	0.0000	0.0000	0.0000	0.0000	425.8225	721.4774	994.7450 (98)
Space heating												5201.7518 (98)
Space heating per m2											(98) / (4) =	46.2542 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1198.1975	943.2619	966.5525	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7782	0.8428	0.8071	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	932.4378	794.9794	780.0982	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1251.4879	1193.9056	1094.1190	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	229.7161	296.8011	233.6315	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												760.1486	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	57.4290	74.2003	58.4079	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												190.0372	(107)
Space cooling per m2												1.6898	(108)
Energy for space heating												46.2542	(99)
Energy for space cooling												1.6898	(108)
Total												47.9441	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9995	0.9987	0.9954	0.9796	0.9215	0.7784	0.6092	0.6812	0.9156	0.9919	0.9989	0.9996	(86)
MIT	19.6483	19.7905	20.0516	20.4121	20.7306	20.9278	20.9841	20.9725	20.8112	20.3897	19.9584	19.6308	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9993	0.9982	0.9936	0.9711	0.8875	0.6922	0.4832	0.5549	0.8643	0.9874	0.9984	0.9995	(89)
MIT 2	18.7343	18.8786	19.1411	19.5071	19.8076	19.9745	20.0053	20.0032	19.8901	19.4904	19.0571	18.7256	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0165	19.1602	19.4222	19.7865	20.0926	20.2688	20.3075	20.3025	20.1745	19.7680	19.3354	19.0050	(93)

8. Space heating requirement

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

8c. Space cooling requirement

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8406	0.9093	0.8749	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	968.0437	824.3662	812.6648	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1153.3137	1100.6204	1014.5894	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	133.3944	205.5331	150.2319	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												489.1594	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	33.3486	51.3833	37.5580	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												122.2898	(107)
Space cooling per m2												1.0874	(108)
Energy for space heating												47.0456	(99)
Energy for space cooling												1.0874	(108)
Total												48.1330	(109)
Target Fabric Energy Efficiency (TFEE)												55.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

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

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

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	11.9814	0.4600	0.0000	0.7700	9.1667	(74)
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	123.1192	216.7324	353.8585	536.0173	645.1173	709.5899	667.0624	581.9215	447.3179	274.8237	157.2388	100.3100	(83)
Total gains	791.8816	880.1181	990.8225	1132.0624	1199.0078	1226.1582	1162.1842	1086.6705	975.9631	844.6197	772.6263	750.4352	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area													
	0.9705	0.9576	0.9231	0.8407	0.6982	0.4839	0.3305	0.3613	0.6458	0.8760	0.9528	0.9744	(86)
MIT	19.3364	19.5272	19.9214	20.3989	20.7644	20.9513	20.9901	20.9868	20.8675	20.4106	19.8091	19.3081	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house													
	0.9648	0.9495	0.9078	0.8093	0.6395	0.3962	0.2249	0.2509	0.5616	0.8436	0.9420	0.9693	(89)
MIT 2	17.7735	18.0506	18.6128	19.2765	19.7452	19.9518	19.9786	19.9809	19.8779	19.3116	18.4672	17.7386	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2560	18.5065	19.0168	19.6230	20.0598	20.2604	20.2908	20.2914	20.1834	19.6509	18.8815	18.2231	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1060	18.3565	18.8668	19.4730	19.9098	20.1104	20.1408	20.1414	20.0334	19.5009	18.7315	18.0731	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9504	0.9324	0.8873	0.7913	0.6353	0.4076	0.2418	0.2684	0.5661	0.8250	0.9244	0.9561	(94)
Useful gains	752.6221	820.5947	879.1075	895.7880	761.7610	499.7909	280.9806	291.6219	552.5412	696.8218	714.1903	717.5207	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1673.9334	1633.7304	1468.5626	1217.4807	878.7761	518.3034	283.1402	294.6587	609.4737	1000.4213	1358.8356	1653.6566	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	685.4555	546.4272	438.5546	231.6187	87.0592	0.0000	0.0000	0.0000	0.0000	225.8781	464.1446	696.4851	(98)
Space heating												3375.6231	(98)
RHI space heating demand												3376	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9757	0.9634	0.9358	0.8730	0.7648	0.6120	0.4728	0.5222	0.7403	0.9081	0.9637	0.9790	(86)
MIT	19.1338	19.3522	19.7348	20.2275	20.6256	20.8727	20.9588	20.9428	20.7529	20.2247	19.5978	19.0979	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9711	0.9565	0.9234	0.8479	0.7181	0.5362	0.3733	0.4211	0.6734	0.8844	0.9557	0.9750	(89)
MIT 2	17.4655	17.7824	18.3324	19.0315	19.5630	19.8673	19.9503	19.9409	19.7395	19.0449	18.1494	17.4203	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.9805	18.2671	18.7654	19.4007	19.8910	20.1777	20.2617	20.2502	20.0523	19.4091	18.5966	17.9382	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8305	18.1171	18.6154	19.2507	19.7410	20.0277	20.1117	20.1002	19.9023	19.2591	18.4466	17.7882	(93)

8. Space heating requirement

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9580	0.9401	0.9031	0.8275	0.7069	0.5405	0.3873	0.4341	0.6684	0.8642	0.9396	0.9631	(94)
Useful gains	744.4132	822.8114	891.7143	920.3762	843.1770	634.4323	433.5180	450.0086	626.7619	709.8336	705.0734	711.9926	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1785.2122	1738.6907	1589.1280	1339.0673	1037.5611	691.8607	447.6247	470.5836	743.1092	1117.3136	1471.7987	1772.2320	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	774.3545	615.4709	518.8757	301.4576	144.6218	0.0000	0.0000	0.0000	0.0000	303.1651	552.0422	788.8181	(98)
Space heating												3998.8059	(98)
Space heating per m2											(98) / (4) =	35.5576	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4418.5701	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	774.3545	615.4709	518.8757	301.4576	144.6218	0.0000	0.0000	0.0000	0.0000	303.1651	552.0422	788.8181	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	855.6404	680.0783	573.3434	333.1024	159.8031	0.0000	0.0000	0.0000	0.0000	334.9890	609.9914	871.6222	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8799	89.8294	89.7125	89.4414	88.9035	87.3000	87.3000	87.3000	87.3000	89.4190	89.7566	89.9036	(217)
Fuel for water heating, kWh/month	199.7538	175.2425	182.1120	160.7240	156.2432	138.9421	130.3772	147.2980	148.3736	166.8536	179.5508	193.8827	(219)
Water heating fuel used												1979.3536	(219)
Annual totals kWh/year													
Space heating fuel - main system												4418.5701	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6933.5259	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4418.5701	3.4800	153.7662	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3536	3.4800	68.8815	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Total energy cost			413.2937	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1024	(257)
SAP value		84.6216	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4418.5701	0.2160	954.4111	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3536	0.2160	427.5404	(264)
Space and water heating			1381.9515	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1659.9291	(272)
CO2 emissions per m2			14.7600	(273)
EI value			85.8738	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

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

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	11.9814	0.4600	0.0000	0.7700	9.1667	(74)
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	123.1192	216.7324	353.8585	536.0173	645.1173	709.5899	667.0624	581.9215	447.3179	274.8237	157.2388	100.3100	(83)
Total gains	791.8816	880.1181	990.8225	1132.0624	1199.0078	1226.1582	1162.1842	1086.6705	975.9631	844.6197	772.6263	750.4352	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area	0.9705	0.9576	0.9231	0.8407	0.6982	0.4839	0.3305	0.3613	0.6458	0.8760	0.9528	0.9744	(86)
MIT	19.3364	19.5272	19.9214	20.3989	20.7644	20.9513	20.9901	20.9868	20.8675	20.4106	19.8091	19.3081	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house	0.9648	0.9495	0.9078	0.8093	0.6395	0.3962	0.2249	0.2509	0.5616	0.8436	0.9420	0.9693	(89)
MIT 2	17.7735	18.0506	18.6128	19.2765	19.7452	19.9518	19.9786	19.9809	19.8779	19.3116	18.4672	17.7386	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2560	18.5065	19.0168	19.6230	20.0598	20.2604	20.2908	20.2914	20.1834	19.6509	18.8815	18.2231	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1060	18.3565	18.8668	19.4730	19.9098	20.1104	20.1408	20.1414	20.0334	19.5009	18.7315	18.0731	(93)

8. Space heating requirement

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

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

Utilisation	0.9504	0.9324	0.8873	0.7913	0.6353	0.4076	0.2418	0.2684	0.5661	0.8250	0.9244	0.9561	(94)
Useful gains	752.6221	820.5947	879.1075	895.7880	761.7610	499.7909	280.9806	291.6219	552.5412	696.8218	714.1903	717.5207	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1673.9334	1633.7304	1468.5626	1217.4807	878.7761	518.3034	283.1402	294.6587	609.4737	1000.4213	1358.8356	1653.6566	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	685.4555	546.4272	438.5546	231.6187	87.0592	0.0000	0.0000	0.0000	0.0000	225.8781	464.1446	696.4851	(98)
Space heating												3375.6231	(98)
Space heating per m2											(98) / (4) =	30.0162	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3729.9702	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	685.4555	546.4272	438.5546	231.6187	87.0592	0.0000	0.0000	0.0000	0.0000	225.8781	464.1446	696.4851	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	757.4094	603.7870	484.5907	255.9323	96.1981	0.0000	0.0000	0.0000	0.0000	249.5890	512.8670	769.5968	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8167	89.7641	89.6085	89.2472	88.5057	87.3000	87.3000	87.3000	87.3000	89.1994	89.6530	89.8408	(217)
Fuel for water heating, kWh/month	199.8944	175.3699	182.3235	161.0738	156.9454	138.9421	130.3772	147.2980	148.3736	167.2643	179.7581	194.0182	(219)
Water heating fuel used												1981.6385	(219)
Annual totals kWh/year													
Space heating fuel - main system												3729.9702	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6247.2110	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3729.9702	3.9200	146.2148	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.6385	3.9200	77.6802	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Total energy cost			402.7332	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3729.9702	0.2160	805.6736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.6385	0.2160	428.0339	(264)
Space and water heating			1233.7075	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1511.6850	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3729.9702	1.2200	4550.5637	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.6385	1.2200	2417.5990	(264)
Space and water heating			6968.1627	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Primary energy kWh/year			8612.4614	(272)

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

Primary energy kWh/m2/year 76.5824 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 31	-192 kg (12.7%)
U Solar photovoltaic panels	+ 8.5	-£ 309	-947 kg (71.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.71 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	8.42 kg/m²	A 94	A 95
Total Savings	£340	10.12 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£91	£99	-£8
Mains gas	£312	£272	£40
Space heating	£247	£247	£0
Water heating	£78	£47	£31
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£403	£62	£341
Total cost of uses	£403	£63	£340
Delivered energy	56 kWh/m²	31 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	17 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9757	0.9634	0.9358	0.8730	0.7648	0.6120	0.4728	0.5222	0.7403	0.9081	0.9637	0.9790	(86)
MIT	19.1338	19.3522	19.7348	20.2275	20.6256	20.8727	20.9588	20.9428	20.7529	20.2247	19.5978	19.0979	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9711	0.9565	0.9234	0.8479	0.7181	0.5362	0.3733	0.4211	0.6734	0.8844	0.9557	0.9750	(89)
MIT 2	17.4655	17.7824	18.3324	19.0315	19.5630	19.8673	19.9503	19.9409	19.7395	19.0449	18.1494	17.4203	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.9805	18.2671	18.7654	19.4007	19.8910	20.1777	20.2617	20.2502	20.0523	19.4091	18.5966	17.9382	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8305	18.1171	18.6154	19.2507	19.7410	20.0277	20.1117	20.1002	19.9023	19.2591	18.4466	17.7882	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9580	0.9401	0.9031	0.8275	0.7069	0.5405	0.3873	0.4341	0.6684	0.8642	0.9396	0.9631	(94)
Useful gains	744.4132	822.8114	891.7143	920.3762	843.1770	634.4323	433.5180	450.0086	626.7619	709.8336	705.0734	711.9926	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1785.2122	1738.6907	1589.1280	1339.0673	1037.5611	691.8607	447.6247	470.5836	743.1092	1117.3136	1471.7987	1772.2320	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	774.3545	615.4709	518.8757	301.4576	144.6218	0.0000	0.0000	0.0000	0.0000	303.1651	552.0422	788.8181	(98)
Space heating												3998.8059	(98)
Space heating per m2											(98) / (4) =	35.5576	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4418.5701	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	774.3545	615.4709	518.8757	301.4576	144.6218	0.0000	0.0000	0.0000	0.0000	303.1651	552.0422	788.8181	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	855.6404	680.0783	573.3434	333.1024	159.8031	0.0000	0.0000	0.0000	0.0000	334.9890	609.9914	871.6222	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9527	89.9808	90.0071	90.0554	90.1115	87.3000	87.3000	87.3000	87.3000	89.7156	89.8682	89.9642	(217)
Fuel for water heating, kWh/month	171.3299	127.8008	101.2430	52.1043	21.3946	4.2204	0.0000	31.1465	57.4037	105.8529	145.7731	170.1045	(219)
Water heating fuel used												988.3736	(219)
Annual totals kWh/year													
Space heating fuel - main system												4418.5701	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4265.3065	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4418.5701	3.4800	153.7662	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.3736	3.4800	34.3954	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			157.5797	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4203	(257)
SAP value		94.1365	
SAP rating (Section 12)		94	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4418.5701	0.2160	954.4111	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.3736	0.2160	213.4887	(264)
Space and water heating			1167.8998	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			575.3901	(272)
CO2 emissions per m2			5.1200	(273)
EI value			95.1034	
EI rating			95	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2007	(H8)
Utilisation factor												0.5652	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-894.4782	(H17)
Solar input	-27.5316	-41.3799	-69.6890	-96.3316	-116.0156	-122.1014	-119.1695	-106.4191	-83.0605	-56.5045	-33.4654	-22.8101	(63)
									Solar input (sum of months) = Sum(63)m =			-894.4782	(63)
Output from w/h	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
									Total per year (kWh/year) = Sum(64)m =			872.5734	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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

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

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.1600	11.9814	0.4600	0.0000	0.7700	9.1667	(74)
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	123.1192	216.7324	353.8585	536.0173	645.1173	709.5899	667.0624	581.9215	447.3179	274.8237	157.2388	100.3100	(83)
Total gains	791.8816	880.1181	990.8225	1132.0624	1199.0078	1226.1582	1162.1842	1086.6705	975.9631	844.6197	772.6263	750.4352	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area													

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

	0.9705	0.9576	0.9231	0.8407	0.6982	0.4839	0.3305	0.3613	0.6458	0.8760	0.9528	0.9744	(86)
MIT	19.3364	19.5272	19.9214	20.3989	20.7644	20.9513	20.9901	20.9868	20.8675	20.4106	19.8091	19.3081	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house													
	0.9648	0.9495	0.9078	0.8093	0.6395	0.3962	0.2249	0.2509	0.5616	0.8436	0.9420	0.9693	(89)
MIT 2	17.7735	18.0506	18.6128	19.2765	19.7452	19.9518	19.9786	19.9809	19.8779	19.3116	18.4672	17.7386	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2560	18.5065	19.0168	19.6230	20.0598	20.2604	20.2908	20.2914	20.1834	19.6509	18.8815	18.2231	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1060	18.3565	18.8668	19.4730	19.9098	20.1104	20.1408	20.1414	20.0334	19.5009	18.7315	18.0731	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9504	0.9324	0.8873	0.7913	0.6353	0.4076	0.2418	0.2684	0.5661	0.8250	0.9244	0.9561	(94)
Useful gains	752.6221	820.5947	879.1075	895.7880	761.7610	499.7909	280.9806	291.6219	552.5412	696.8218	714.1903	717.5207	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1673.9334	1633.7304	1468.5626	1217.4807	878.7761	518.3034	283.1402	294.6587	609.4737	1000.4213	1358.8356	1653.6566	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	685.4555	546.4272	438.5546	231.6187	87.0592	0.0000	0.0000	0.0000	0.0000	225.8781	464.1446	696.4851	(98)
Space heating												3375.6231	(98)
Space heating per m2											(98) / (4) =	30.0162	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3729.9702	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	685.4555	546.4272	438.5546	231.6187	87.0592	0.0000	0.0000	0.0000	0.0000	225.8781	464.1446	696.4851	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	757.4094	603.7870	484.5907	255.9323	96.1981	0.0000	0.0000	0.0000	0.0000	249.5890	512.8670	769.5968	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9019	89.9226	89.9198	89.9397	89.8146	87.3000	87.3000	87.3000	87.3000	89.5450	89.7899	89.9112	(217)
Fuel for water heating, kWh/month													
	169.0809	129.0435	104.1909	52.7267	25.4859	0.0000	0.0000	25.3976	53.2299	103.5170	142.2134	168.4967	(219)
Water heating fuel used												973.3824	(219)
Annual totals kWh/year													
Space heating fuel - main system												3729.9702	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3464.7952	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3729.9702	3.9200	146.2148	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.3824	3.9200	38.1566	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			62.3121	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3729.9702	0.2160	805.6736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.3824	0.2160	210.2506	(264)
Space and water heating			1015.9242	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			373.1129	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3729.9702	1.2200	4550.5637	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.3824	1.2200	1187.5265	(264)
Space and water heating			5738.0902	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1935.7189	(272)
Primary energy kWh/m2/year			17.2125	(273)

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

Overheating Calculation Input Data

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

Overheating Calculation

Summer ventilation heat loss coefficient		384.18 (P1)
Transmission heat loss coefficient		73.87 (37)
Summer heat loss coefficient		458.04 (P2)

Overhangs

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

Solar shading

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

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

	Jun	Jul	Aug	
Solar gains	821	772	674	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1335	1264	1175	(P5)
Summer gain/loss ratio	2.91	2.76	2.57	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.96	21.70	21.41	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-306	**Issued on Date**	19/10/2022
Assessment Reference	Plot 306	**Prop Type Ref**	Ebbertson-Opp-SEMI
Property	Plot 306, 3 Bed, K, WC, B, Es		

SAP Rating	85 B	**DER**	15.94	**TER**	17.18
Environmental	86 B	**% DER<TER**	7.22		
CO_2 Emissions (t/year)	1.49	**DFEE**	46.82	**TFEE**	53.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.21		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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

Semi-Detached House, total floor area 112 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.18 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.94 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.8 kWh/m²/yrOK
---
2 Fabric U-values

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

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

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

Hot water controls: No cylinder

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	584.1797	700.6792	828.0568	961.0263	1045.3046	1030.3837	983.0985	906.6386	808.9465	676.7959	578.5493	547.7398	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9889	0.9797	0.9584	0.9072	0.8122	0.6685	0.5266	0.5797	0.7960	0.9417	0.9819	0.9909	(86)
MIT	18.9007	19.1497	19.5660	20.0986	20.5434	20.8342	20.9436	20.9224	20.6873	20.0834	19.3964	18.8633	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9867	0.9756	0.9497	0.8871	0.7699	0.5925	0.4200	0.4734	0.7347	0.9250	0.9776	0.9891	(89)
MIT 2	17.1284	17.4917	18.0949	18.8591	19.4645	19.8313	19.9408	19.9268	19.6687	18.8535	17.8612	17.0804	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6756	18.0036	18.5491	19.2418	19.7976	20.1409	20.2504	20.2341	19.9832	19.2332	18.3352	17.6308	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5256	17.8536	18.3991	19.0918	19.6476	19.9909	20.1004	20.0841	19.8332	19.0832	18.1852	17.4808	(93)

8. Space heating requirement

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9789	0.9638	0.9324	0.8662	0.7551	0.5939	0.4339	0.4855	0.7252	0.9060	0.9668	0.9824	(94)
Useful gains	571.8304	675.3481	772.1033	832.4244	789.3483	611.9881	426.6127	440.1905	586.6496	613.2006	559.3308	538.1085	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1744.9761	1704.0284	1560.7625	1318.5047	1025.5027	687.1656	446.1890	468.5415	734.2528	1094.6130	1437.8916	1732.1442	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	872.8204	691.2732	586.7624	349.9778	175.6989	0.0000	0.0000	0.0000	0.0000	358.1708	632.5638	888.3626	(98)

Space heating 4555.6299 (98)
Space heating per m2 (98) / (4) = 40.5089 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5033.8452 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	872.8204	691.2732	586.7624	349.9778	175.6989	0.0000	0.0000	0.0000	0.0000	358.1708	632.5638	888.3626	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	964.4424	763.8378	648.3563	386.7158	194.1425	0.0000	0.0000	0.0000	0.0000	395.7689	698.9655	981.6161	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9376	89.8888	89.7832	89.5443	89.0587	87.3000	87.3000	87.3000	87.3000	89.5349	89.8314	89.9591	(217)
Fuel for water heating, kWh/month	199.6257	175.1265	181.9686	160.5392	155.9710	138.9421	130.3772	147.2980	148.3736	166.6376	179.4011	193.7630	(219)

Water heating fuel used 1978.0237 (219)
Annual totals kWh/year
Space heating fuel - main system 5033.8452 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 460.6022 (232)
Total delivered energy for all uses 7547.4711 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5033.8452	0.2160	1087.3106	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1978.0237	0.2160	427.2531	(264)
Space and water heating			1514.5637	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/year			1792.5412	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9400	(273)

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

DER		15.9400	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		32.0946	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.0946	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

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	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
									Total per year (kWh/year) = Sum(64)m =			2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

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

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

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7. Mean internal temperature (heating season)

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

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

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

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8. Space heating requirement

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

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

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

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

Solar gains	135.9544	254.8621	398.6300	558.1119	669.6234	680.5868	649.8581	566.7393	455.1824	296.2875	167.3708	113.2617	(83)
Total gains	549.7488	667.0978	796.2393	931.6076	1017.4468	1004.7214	959.2986	880.4486	781.9045	647.2712	546.2219	514.1548	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8794	31.9740	32.0673	32.5127	32.5974	32.9977	32.9977	33.0729	32.8424	32.5974	32.4265	32.2497	
alpha	3.1253	3.1316	3.1378	3.1675	3.1732	3.1998	3.1998	3.2049	3.1895	3.1732	3.1618	3.1500	
util living area	0.9902	0.9815	0.9611	0.9116	0.8190	0.6775	0.5359	0.5912	0.8056	0.9462	0.9839	0.9920	(86)
MIT	18.8334	19.0872	19.5127	20.0587	20.5175	20.8216	20.9383	20.9147	20.6653	20.0403	19.3378	18.7961	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9882	0.9777	0.9530	0.8924	0.7778	0.6021	0.4286	0.4845	0.7461	0.9308	0.9801	0.9904	(89)
MIT 2	17.9558	18.2098	18.6320	19.1719	19.6009	19.8680	19.9487	19.9384	19.7473	19.1656	18.4701	17.9265	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.2267	18.4807	18.9039	19.4457	19.8839	20.1624	20.2542	20.2398	20.0307	19.4356	18.7380	18.1950	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2267	18.4807	18.9039	19.4457	19.8839	20.1624	20.2542	20.2398	20.0307	19.4356	18.7380	18.1950	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9708	0.9428	0.8810	0.7743	0.6171	0.4596	0.5139	0.7502	0.9208	0.9740	0.9867	(94)
Useful gains	540.8172	647.6488	750.6850	820.7433	787.8242	620.0396	440.8513	452.4410	586.5473	596.0243	532.0064	507.2930	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1837.4856	1786.5266	1626.9747	1364.2858	1055.9913	709.0219	465.7953	488.3402	759.5507	1140.0905	1509.6061	1825.2883	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

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	964.7213	765.3259	651.9595	391.3506	199.5163	0.0000	0.0000	0.0000	0.0000	404.7852	703.8718	980.5885 (98)
Space heating												5062.1191 (98)
Space heating per m2											(98) / (4) =	45.0126 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1198.1975	943.2619	966.5525	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7861	0.8501	0.8194	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	941.8834	801.8975	791.9887	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1278.8180	1223.7154	1134.9394	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	242.5930	313.8325	255.1554	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												811.5809	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	60.6482	78.4581	63.7888	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												202.8952	(107)
Space cooling per m2												1.8042	(108)
Energy for space heating												45.0126	(99)
Energy for space cooling												1.8042	(108)
Total												46.8168	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

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

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

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

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

4. Water heating energy requirements (kWh/year)

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

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

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

8. Space heating requirement

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

8c. Space cooling requirement

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

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

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Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8490	0.9159	0.8869	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	977.6694	830.3262	823.8374	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1176.8948	1126.3410	1049.8104	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	143.4423	220.2351	168.1239	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												531.8013	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	35.8606	55.0588	42.0310	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												132.9503	(107)
Space cooling per m2												1.1822	(108)
Energy for space heating												45.7223	(99)
Energy for space cooling												1.1822	(108)
Total												46.9045	(109)
Target Fabric Energy Efficiency (TFEE)												53.9	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

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

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

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
South	2.1600	50.9848	0.4600	0.0000	0.7700	39.0071	(78)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	152.9596	258.1605	398.9120	575.3596	672.4073	731.3781	690.7956	616.1175	493.6801	320.4811	192.9525	126.1701	(83)
Total gains	821.7220	921.5461	1035.8760	1171.4047	1226.2978	1247.9463	1185.9173	1120.8665	1022.3253	890.2772	808.3400	776.2953	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area													
	0.9675	0.9524	0.9147	0.8300	0.6887	0.4767	0.3242	0.3510	0.6255	0.8618	0.9471	0.9719	(86)
MIT	19.3708	19.5726	19.9644	20.4258	20.7741	20.9534	20.9906	20.9879	20.8796	20.4464	19.8476	19.3385	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house													
	0.9612	0.9434	0.8983	0.7974	0.6297	0.3899	0.2205	0.2435	0.5416	0.8270	0.9352	0.9664	(89)
MIT 2	17.8228	18.1149	18.6720	19.3108	19.7556	19.9533	19.9787	19.9813	19.8886	19.3572	18.5212	17.7822	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3007	18.5650	19.0710	19.6550	20.0700	20.2620	20.2911	20.2920	20.1945	19.6934	18.9307	18.2627	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1507	18.4150	18.9210	19.5050	19.9200	20.1120	20.1411	20.1420	20.0445	19.5434	18.7807	18.1127	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9461	0.9254	0.8774	0.7800	0.6262	0.4013	0.2371	0.2605	0.5471	0.8092	0.9168	0.9526	(94)
Useful gains	777.4318	852.7878	908.8278	913.7455	767.8572	500.8165	281.1416	291.9571	559.2869	720.3959	741.1185	739.4640	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1679.6909	1641.2233	1475.4995	1221.5454	880.0710	518.5113	283.1773	294.7343	610.8765	1005.8105	1365.0652	1658.7006	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	671.2808	529.8287	421.6037	221.6159	83.4871	0.0000	0.0000	0.0000	0.0000	212.3485	449.2417	683.9120	(98)
Space heating												3273.3184	(98)
RHI space heating demand												3273	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

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

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

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9733	0.9586	0.9282	0.8630	0.7550	0.6034	0.4638	0.5082	0.7209	0.8967	0.9596	0.9771	(86)
MIT	19.1661	19.4002	19.7829	20.2601	20.6407	20.8779	20.9610	20.9472	20.7726	20.2646	19.6340	19.1266	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9683	0.9509	0.9146	0.8367	0.7076	0.5278	0.3656	0.4088	0.6527	0.8709	0.9507	0.9728	(89)
MIT 2	17.5120	17.8507	18.3995	19.0745	19.5806	19.8721	19.9517	19.9437	19.7601	19.0979	18.2008	17.4617	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0227	18.3290	18.8266	19.4406	19.9079	20.1826	20.2633	20.2535	20.0727	19.4581	18.6433	17.9757	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8727	18.1790	18.6766	19.2906	19.7579	20.0326	20.1133	20.1035	19.9227	19.3081	18.4933	17.8257	(93)

8. Space heating requirement

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9545	0.9336	0.8937	0.8167	0.6972	0.5325	0.3795	0.4219	0.6492	0.8507	0.9338	0.9602	(94)
Useful gains	768.0674	857.2786	925.5082	942.5658	853.0190	637.4588	434.5271	452.0562	638.7477	736.8173	730.9449	733.0212	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1790.7743	1746.8463	1597.1566	1344.2190	1039.7361	692.4866	447.8339	471.0070	745.7114	1123.6312	1477.8627	1777.1222	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	760.8939	597.7895	499.7064	289.1903	138.9175	0.0000	0.0000	0.0000	0.0000	287.7896	537.7808	776.8111	(98)
Space heating												3888.8791	(98)
Space heating per m2											(98) / (4) =	34.5801	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4297.1040	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	760.8939	597.7895	499.7064	289.1903	138.9175	0.0000	0.0000	0.0000	0.0000	287.7896	537.7808	776.8111	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	840.7668	660.5409	552.1618	319.5473	153.5000	0.0000	0.0000	0.0000	0.0000	317.9995	594.2329	858.3548	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8711	89.8138	89.6900	89.4118	88.8713	87.3000	87.3000	87.3000	87.3000	89.3814	89.7415	89.8961	(217)
Fuel for water heating, kWh/month	199.7734	175.2729	182.1579	160.7772	156.2998	138.9421	130.3772	147.2980	148.3736	166.9238	179.5808	193.8988	(219)
Water heating fuel used												1979.6756	(219)
Annual totals kWh/year													
Space heating fuel - main system												4297.1040	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6812.3818	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4297.1040	3.4800	149.5392	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.6756	3.4800	68.8927	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Total energy cost			409.0779	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0912	(257)
SAP value		84.7784	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4297.1040	0.2160	928.1745	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.6756	0.2160	427.6099	(264)
Space and water heating			1355.7844	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1633.7619	(272)
CO2 emissions per m2			14.5300	(273)
EI value			86.0965	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

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

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

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

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

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

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
South	2.1600	50.9848	0.4600	0.0000	0.7700	39.0071	(78)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	152.9596	258.1605	398.9120	575.3596	672.4073	731.3781	690.7956	616.1175	493.6801	320.4811	192.9525	126.1701	(83)
Total gains	821.7220	921.5461	1035.8760	1171.4047	1226.2978	1247.9463	1185.9173	1120.8665	1022.3253	890.2772	808.3400	776.2953	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area	0.9675	0.9524	0.9147	0.8300	0.6887	0.4767	0.3242	0.3510	0.6255	0.8618	0.9471	0.9719	(86)
MIT	19.3708	19.5726	19.9644	20.4258	20.7741	20.9534	20.9906	20.9879	20.8796	20.4464	19.8476	19.3385	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house	0.9612	0.9434	0.8983	0.7974	0.6297	0.3899	0.2205	0.2435	0.5416	0.8270	0.9352	0.9664	(89)
MIT 2	17.8228	18.1149	18.6720	19.3108	19.7556	19.9533	19.9787	19.9813	19.8886	19.3572	18.5212	17.7822	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3007	18.5650	19.0710	19.6550	20.0700	20.2620	20.2911	20.2920	20.1945	19.6934	18.9307	18.2627	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1507	18.4150	18.9210	19.5050	19.9200	20.1120	20.1411	20.1420	20.0445	19.5434	18.7807	18.1127	(93)

8. Space heating requirement

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

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

Utilisation	0.9461	0.9254	0.8774	0.7800	0.6262	0.4013	0.2371	0.2605	0.5471	0.8092	0.9168	0.9526	(94)
Useful gains	777.4318	852.7878	908.8278	913.7455	767.8572	500.8165	281.1416	291.9571	559.2869	720.3959	741.1185	739.4640	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1679.6909	1641.2233	1475.4995	1221.5454	880.0710	518.5113	283.1773	294.7343	610.8765	1005.8105	1365.0652	1658.7006	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	671.2808	529.8287	421.6037	221.6159	83.4871	0.0000	0.0000	0.0000	0.0000	212.3485	449.2417	683.9120	(98)
Space heating												3273.3184	(98)
Space heating per m2											(98) / (4) =	29.1065	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3616.9264	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	671.2808	529.8287	421.6037	221.6159	83.4871	0.0000	0.0000	0.0000	0.0000	212.3485	449.2417	683.9120	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	741.7467	585.4461	465.8605	244.8795	92.2509	0.0000	0.0000	0.0000	0.0000	234.6392	496.3996	755.7039	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8054	89.7465	89.5829	89.2134	88.4744	87.3000	87.3000	87.3000	87.3000	89.1515	89.6326	89.8312	(217)
Fuel for water heating, kWh/month	199.9196	175.4043	182.3755	161.1348	157.0009	138.9421	130.3772	147.2980	148.3736	167.3543	179.7992	194.0389	(219)
Water heating fuel used												1982.0185	(219)
Annual totals kWh/year													
Space heating fuel - main system												3616.9264	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6134.5471	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3616.9264	3.9200	141.7835	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1982.0185	3.9200	77.6951	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Total energy cost			398.3168	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3616.9264	0.2160	781.2561	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1982.0185	0.2160	428.1160	(264)
Space and water heating			1209.3721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1487.3496	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3616.9264	1.2200	4412.6502	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1982.0185	1.2200	2418.0625	(264)
Space and water heating			6830.7128	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Primary energy kWh/year			8475.0116	(272)

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

Primary energy kWh/m2/year 75.3602 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 31	-192 kg (12.9%)
U Solar photovoltaic panels	+ 8.5	-£ 309	-947 kg (73.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.71 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.42 kg/m²	A 94	A 95
Total Savings	£340	10.12 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£91	£99	-£8
Mains gas	£307	£268	£40
Space heating	£243	£243	£0
Water heating	£78	£47	£31
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£398	£58	£341
Total cost of uses	£399	£59	£340
Delivered energy	55 kWh/m²	30 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	16 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)

Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1079.5246	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1813.6014	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.1369	(H8)
Utilisation factor	0.5850	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	101.3843	(H14)
Volume ratio Veff/V	0.7398	(H15)
Solar storage volume factor	0.9397	(H16)
Solar input	-876.7033	(H17)

Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
								Solar input (sum of months) = Sum(63)m =				-876.7033	(63)
Output from w/h													
	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
								Total per year (kWh/year) = Sum(64)m =				886.4316	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

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

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

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866
util living area												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9733	0.9586	0.9282	0.8630	0.7550	0.6034	0.4638	0.5082	0.7209	0.8967	0.9596	0.9771	(86)
MIT	19.1661	19.4002	19.7829	20.2601	20.6407	20.8779	20.9610	20.9472	20.7726	20.2646	19.6340	19.1266	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9683	0.9509	0.9146	0.8367	0.7076	0.5278	0.3656	0.4088	0.6527	0.8709	0.9507	0.9728	(89)
MIT 2	17.5120	17.8507	18.3995	19.0745	19.5806	19.8721	19.9517	19.9437	19.7601	19.0979	18.2008	17.4617	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0227	18.3290	18.8266	19.4406	19.9079	20.1826	20.2633	20.2535	20.0727	19.4581	18.6433	17.9757	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8727	18.1790	18.6766	19.2906	19.7579	20.0326	20.1133	20.1035	19.9227	19.3081	18.4933	17.8257	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9545	0.9336	0.8937	0.8167	0.6972	0.5325	0.3795	0.4219	0.6492	0.8507	0.9338	0.9602	(94)
Useful gains	768.0674	857.2786	925.5082	942.5658	853.0190	637.4588	434.5271	452.0562	638.7477	736.8173	730.9449	733.0212	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1790.7743	1746.8463	1597.1566	1344.2190	1039.7361	692.4866	447.8339	471.0070	745.7114	1123.6312	1477.8627	1777.1222	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	760.8939	597.7895	499.7064	289.1903	138.9175	0.0000	0.0000	0.0000	0.0000	287.7896	537.7808	776.8111	(98)
Space heating												3888.8791	(98)
Space heating per m2											(98) / (4) =	34.5801	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4297.1040	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	760.8939	597.7895	499.7064	289.1903	138.9175	0.0000	0.0000	0.0000	0.0000	287.7896	537.7808	776.8111	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	840.7668	660.5409	552.1618	319.5473	153.5000	0.0000	0.0000	0.0000	0.0000	317.9995	594.2329	858.3548	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9447	89.9680	89.9912	90.0393	90.0975	87.3000	87.3000	87.3000	87.3000	89.6844	89.8548	89.9573	(217)
Fuel for water heating, kWh/month	171.3451	127.8190	101.2609	52.1136	21.3979	4.2204	0.0000	31.1465	57.4037	105.8897	145.7948	170.1175	(219)
Water heating fuel used												988.5091	(219)
Annual totals kWh/year													
Space heating fuel - main system												4297.1040	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4143.9759	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4297.1040	3.4800	149.5392	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.5091	3.4800	34.4001	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			153.3574	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4091	(257)
SAP value		94.2937	
SAP rating (Section 12)		94	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4297.1040	0.2160	928.1745	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.5091	0.2160	213.5180	(264)
Space and water heating			1141.6924	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			549.1827	(272)
CO2 emissions per m2			4.8800	(273)
EI value			95.3264	
EI rating			95	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)

Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1140.0998	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1915.3676	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.2007	(H8)
Utilisation factor	0.5652	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	101.3843	(H14)
Volume ratio Veff/V	0.7398	(H15)
Solar storage volume factor	0.9397	(H16)
Solar input	-894.4782	(H17)

Solar input	-27.5316	-41.3799	-69.6890	-96.3316	-116.0156	-122.1014	-119.1695	-106.4191	-83.0605	-56.5045	-33.4654	-22.8101	(63)
								Solar input (sum of months) = Sum(63)m =				-894.4782	(63)
Output from w/h	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
								Total per year (kWh/year) = Sum(64)m =				872.5734	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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

Metabolic gains (Table 5), Watts

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

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.1700	22.3313	0.4600	0.0000	0.7700	17.1642	(76)
South	2.1600	50.9848	0.4600	0.0000	0.7700	39.0071	(78)
West	5.8100	22.3313	0.4600	0.0000	0.7700	45.9557	(80)
East	5.4600	22.3313	0.4600	0.0000	0.7700	43.1872	(76)
East	0.6500	29.6355	0.6300	0.7000	1.0000	7.6455	(82)

Solar gains	152.9596	258.1605	398.9120	575.3596	672.4073	731.3781	690.7956	616.1175	493.6801	320.4811	192.9525	126.1701	(83)
Total gains	821.7220	921.5461	1035.8760	1171.4047	1226.2978	1247.9463	1185.9173	1120.8665	1022.3253	890.2772	808.3400	776.2953	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373
util living area												

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

	0.9675	0.9524	0.9147	0.8300	0.6887	0.4767	0.3242	0.3510	0.6255	0.8618	0.9471	0.9719	(86)
MIT	19.3708	19.5726	19.9644	20.4258	20.7741	20.9534	20.9906	20.9879	20.8796	20.4464	19.8476	19.3385	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house													
	0.9612	0.9434	0.8983	0.7974	0.6297	0.3899	0.2205	0.2435	0.5416	0.8270	0.9352	0.9664	(89)
MIT 2	17.8228	18.1149	18.6720	19.3108	19.7556	19.9533	19.9787	19.9813	19.8886	19.3572	18.5212	17.7822	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3007	18.5650	19.0710	19.6550	20.0700	20.2620	20.2911	20.2920	20.1945	19.6934	18.9307	18.2627	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1507	18.4150	18.9210	19.5050	19.9200	20.1120	20.1411	20.1420	20.0445	19.5434	18.7807	18.1127	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9461	0.9254	0.8774	0.7800	0.6262	0.4013	0.2371	0.2605	0.5471	0.8092	0.9168	0.9526	(94)
Useful gains	777.4318	852.7878	908.8278	913.7455	767.8572	500.8165	281.1416	291.9571	559.2869	720.3959	741.1185	739.4640	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1679.6909	1641.2233	1475.4995	1221.5454	880.0710	518.5113	283.1773	294.7343	610.8765	1005.8105	1365.0652	1658.7006	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	671.2808	529.8287	421.6037	221.6159	83.4871	0.0000	0.0000	0.0000	0.0000	212.3485	449.2417	683.9120	(98)
Space heating												3273.3184	(98)
Space heating per m2											(98) / (4) =	29.1065	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3616.9264	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	671.2808	529.8287	421.6037	221.6159	83.4871	0.0000	0.0000	0.0000	0.0000	212.3485	449.2417	683.9120	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	741.7467	585.4461	465.8605	244.8795	92.2509	0.0000	0.0000	0.0000	0.0000	234.6392	496.3996	755.7039	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8916	89.9079	89.9009	89.9190	89.7918	87.3000	87.3000	87.3000	87.3000	89.5031	89.7717	89.9024	(217)
Fuel for water heating, kWh/month													
	169.1002	129.0646	104.2129	52.7388	25.4923	0.0000	0.0000	25.3976	53.2299	103.5655	142.2422	168.5132	(219)
Water heating fuel used												973.5572	(219)
Annual totals kWh/year													
Space heating fuel - main system												3616.9264	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3351.9262	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3616.9264	3.9200	141.7835	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.5572	3.9200	38.1634	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			57.8876	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3616.9264	0.2160	781.2561	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.5572	0.2160	210.2883	(264)
Space and water heating			991.5445	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			348.7332	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3616.9264	1.2200	4412.6502	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.5572	1.2200	1187.7398	(264)
Space and water heating			5600.3900	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1798.0187	(272)
Primary energy kWh/m2/year			15.9881	(273)

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

Overheating Calculation Input Data

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

Overheating Calculation

Summer ventilation heat loss coefficient		384.18 (P1)
Transmission heat loss coefficient		73.87 (37)
Summer heat loss coefficient		458.04 (P2)

Overhangs

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

Solar shading

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

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

	Jun	Jul	Aug	
Solar gains	847	800	714	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1360	1292	1215	(P5)
Summer gain/loss ratio	2.97	2.82	2.65	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	20.01	21.76	21.49	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-307	**Issued on Date**	19/10/2022
Assessment Reference	Plot 307	**Prop Type Ref**	3T-As-SEMI
Property	Plot 307, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	16.13	**TER**	17.77
Environmental	86 B	**% DER<TER**	9.24		
CO_2 Emissions (t/year)	1.46	**DFEE**	47.53	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.70		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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

Semi-Detached House, total floor area 108 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.13 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.5 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

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

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9908	0.9849	0.9704	0.9329	0.8552	0.7247	0.5851	0.6410	0.8438	0.9575	0.9857	0.9923	(86)
MIT	18.8978	19.1033	19.4845	20.0013	20.4662	20.7934	20.9259	20.8987	20.6267	20.0178	19.3705	18.8653	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9889	0.9818	0.9641	0.9173	0.8191	0.6519	0.4744	0.5331	0.7907	0.9448	0.9823	0.9908	(89)
MIT 2	17.1369	17.4374	17.9919	18.7393	19.3836	19.8059	19.9445	19.9244	19.6139	18.7749	17.8353	17.0949	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.3785	17.6661	18.1967	18.9125	19.5322	19.9414	20.0792	20.0581	19.7529	18.9455	18.0460	17.3379	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2285	17.5161	18.0467	18.7625	19.3822	19.7914	19.9292	19.9081	19.6029	18.7955	17.8960	17.1879	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8927	0.7932	0.6355	0.4671	0.5231	0.7657	0.9234	0.9713	0.9839	(94)
Useful gains	516.7022	586.6338	658.5678	712.7909	688.4699	544.8594	380.8218	391.8394	510.5142	527.3126	496.3366	490.3204	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1608.5246	1565.6119	1429.2942	1206.2987	937.5059	626.8857	402.0146	422.7886	667.2143	1000.1435	1323.5166	1599.7927	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	812.3158	657.8733	573.4204	355.3256	185.2828	0.0000	0.0000	0.0000	0.0000	351.7862	595.5696	825.4474	(98)
Space heating												4357.0212	(98)
Space heating per m2											(98) / (4) =	40.1865	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4814.3881	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	812.3158	657.8733	573.4204	355.3256	185.2828	0.0000	0.0000	0.0000	0.0000	351.7862	595.5696	825.4474	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	897.5865	726.9318	633.6137	392.6250	204.7324	0.0000	0.0000	0.0000	0.0000	388.7140	658.0880	912.0966	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9045	89.8650	89.7713	89.5554	89.1016	87.3000	87.3000	87.3000	87.3000	89.5237	89.8000	89.9262	(217)
Fuel for water heating, kWh/month													
	199.2924	174.8318	181.6751	160.2881	155.7065	138.8278	130.3257	147.1641	148.2179	166.4188	179.1397	193.4562	(219)
Water heating fuel used												1975.3441	(219)
Annual totals kWh/year													
Space heating fuel - main system												4814.3881	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7333.3139	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4814.3881	0.2160	1039.9078	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.3441	0.2160	426.6743	(264)
Space and water heating			1466.5822	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1748.7011	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.1300	(273)

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

DER		16.1300	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.5655	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.5655	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
										Total per year (kWh/year) = Sum(64)m =		2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	126.1377	125.7512	125.3723	123.5927	123.2597	121.7097	121.7097	121.4227	122.3068	123.2597	123.9333	124.6375	(39)
Average = Sum(39)m / 12 =												123.5911	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1634	1.1599	1.1564	1.1399	1.1369	1.1226	1.1226	1.1199	1.1281	1.1369	1.1431	1.1496	(40)
HLP (average)												1.1399	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1369	32.2357	32.3331	32.7987	32.8873	33.3061	33.3061	33.3848	33.1435	32.8873	32.7085	32.5237	
alpha	3.1425	3.1490	3.1555	3.1866	3.1925	3.2204	3.2204	3.2257	3.2096	3.1925	3.1806	3.1682	
util living area	0.9920	0.9866	0.9732	0.9378	0.8640	0.7375	0.5997	0.6575	0.8556	0.9621	0.9877	0.9934	(86)
MIT	18.8013	19.0123	19.4043	19.9409	20.4243	20.7723	20.9162	20.8854	20.5928	19.9581	19.2917	18.7734	(87)
Th 2	19.9494	19.9523	19.9551	19.9683	19.9708	19.9824	19.9824	19.9846	19.9780	19.9708	19.9658	19.9605	(88)
util rest of house	0.9904	0.9839	0.9674	0.9233	0.8293	0.6656	0.4877	0.5493	0.8049	0.9506	0.9847	0.9920	(89)
MIT 2	17.9297	18.1416	18.5325	19.0683	19.5289	19.8427	19.9471	19.9320	19.6979	19.0942	18.4307	17.9098	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0493	18.2611	18.6522	19.1881	19.6518	19.9703	20.0801	20.0629	19.8207	19.2127	18.5489	18.0283	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0493	18.2611	18.6522	19.1881	19.6518	19.9703	20.0801	20.0629	19.8207	19.2127	18.5489	18.0283	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9777	0.9577	0.9094	0.8165	0.6646	0.4995	0.5586	0.7955	0.9393	0.9789	0.9885	(94)
Useful gains	485.4403	558.0760	635.5838	699.3080	685.9638	552.6799	395.2349	403.7675	508.7925	508.5729	468.5030	459.3457	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1734.3044	1680.1755	1523.5459	1271.5289	980.1386	653.6208	423.5619	444.7569	699.6796	1061.6039	1418.8999	1723.5286	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	929.1549	754.0509	660.6438	411.9990	218.8660	0.0000	0.0000	0.0000	0.0000	411.4551	684.2858	940.5521	(98)
Space heating												5011.0075	(98)
Space heating per m2											(98) / (4) =	46.2185	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1144.0714	900.6520	922.8124	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7416	0.8125	0.7764	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	848.4069	731.8142	716.5005	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	168.6108	224.2339	177.7604	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												570.6051	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.1527	56.0585	44.4401	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.6513	(107)
Space cooling per m2												1.3157	(108)
Energy for space heating												46.2185	(99)
Energy for space cooling												1.3157	(108)
Total												47.5342	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)	
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)	
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)	
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												332.3747 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												83.0937 (107)
Space cooling per m2												0.7664 (108)
Energy for space heating												47.6900 (99)
Energy for space cooling												0.7664 (108)
Total												48.4564 (109)
Target Fabric Energy Efficiency (TFEE)												55.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3572	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693	(89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480 (98)
Space heating												3123.6617 (98)
RHI space heating demand												3124 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9757	0.9655	0.9427	0.8904	0.7956	0.6503	0.5082	0.5550	0.7641	0.9149	0.9645	0.9788	(86)
MIT	19.1746	19.3681	19.7198	20.1858	20.5859	20.8522	20.9511	20.9341	20.7342	20.2177	19.6203	19.1393	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9712	0.9590	0.9315	0.8680	0.7521	0.5751	0.4052	0.4520	0.6999	0.8928	0.9567	0.9748	(89)
MIT 2	17.5375	17.8184	18.3253	18.9901	19.5310	19.8633	19.9612	19.9501	19.7344	19.0486	18.1936	17.4921	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7622	18.0311	18.5167	19.1542	19.6758	19.9990	20.0970	20.0852	19.8716	19.2091	18.3894	17.7181	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6122	17.8811	18.3667	19.0042	19.5258	19.8490	19.9470	19.9352	19.7216	19.0591	18.2394	17.5681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8414	0.7296	0.5636	0.4006	0.4458	0.6804	0.8666	0.9378	0.9610	(94)
Useful gains	712.0004	770.6538	817.7740	832.2088	761.5200	575.8632	390.5889	406.5362	571.2762	657.0913	668.6588	683.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.2525	1610.9158	1468.9001	1235.8576	955.0294	633.8441	404.1700	426.0469	681.6128	1032.3103	1365.6152	1646.6284	(97)

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Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating												3683.4464	(98)
Space heating per m2											(98) / (4) =	33.9739	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4070.1065	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	776.2692	623.9293	535.2904	321.1349	159.0839	0.0000	0.0000	0.0000	0.0000	308.4673	554.4846	791.4469	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8309	89.7836	89.6721	89.4164	88.9008	87.3000	87.3000	87.3000	87.3000	89.3602	89.7018	89.8563	(217)
Fuel for water heating, kWh/month	199.4557	174.9902	181.8761	160.5374	156.0581	138.8278	130.3257	147.1641	148.2179	166.7233	179.3357	193.6067	(219)
Water heating fuel used												1977.1187	(219)
Annual totals kWh/year													
Space heating fuel - main system												4070.1065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6590.8070	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4070.1065	3.4800	141.6397	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.1187	3.4800	68.8037	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			402.1419	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1009	(257)
SAP value		84.6425	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4070.1065	0.2160	879.1430	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.1187	0.2160	427.0576	(264)
Space and water heating			1306.2007	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1588.3196	(272)
CO2 emissions per m2			14.6500	(273)
EI value			86.1273	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693	(89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568	(97)

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

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating												3123.6617	(98)
Space heating per m2											(98) / (4) =	28.8108	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3451.5599	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	690.3134	557.0119	455.6046	249.8163	96.9078	0.0000	0.0000	0.0000	0.0000	231.6142	469.0232	701.2686	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7666	89.7186	89.5694	89.2298	88.5122	87.3000	87.3000	87.3000	87.3000	89.1424	89.5974	89.7919	(217)
Fuel for water heating, kWh/month	199.5984	175.1171	182.0846	160.8730	156.7434	138.8278	130.3257	147.1641	148.2179	167.1306	179.5447	193.7456	(219)
Water heating fuel used												1979.3730	(219)
Annual totals kWh/year													
Space heating fuel - main system												3451.5599	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5974.5147	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3451.5599	3.9200	135.3011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3730	3.9200	77.5914	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			393.0840	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3451.5599	0.2160	745.5369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3730	0.2160	427.5446	(264)
Space and water heating			1173.0815	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1455.2004	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3451.5599	1.2200	4210.9031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3730	1.2200	2414.8350	(264)
Space and water heating			6625.7382	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8294.5341	(272)
Primary energy kWh/m2/year			76.5037	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-191 kg (13.2%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (74.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 94	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£301	£261	£39
Space heating	£236	£236	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£393	£53	£340
Total cost of uses	£393	£53	£340
Delivered energy	55 kWh/m²	29 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	15 kWh/m²	62 kWh/m²

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9757	0.9655	0.9427	0.8904	0.7956	0.6503	0.5082	0.5550	0.7641	0.9149	0.9645	0.9788	(86)
MIT	19.1746	19.3681	19.7198	20.1858	20.5859	20.8522	20.9511	20.9341	20.7342	20.2177	19.6203	19.1393	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9712	0.9590	0.9315	0.8680	0.7521	0.5751	0.4052	0.4520	0.6999	0.8928	0.9567	0.9748	(89)
MIT 2	17.5375	17.8184	18.3253	18.9901	19.5310	19.8633	19.9612	19.9501	19.7344	19.0486	18.1936	17.4921	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7622	18.0311	18.5167	19.1542	19.6758	19.9990	20.0970	20.0852	19.8716	19.2091	18.3894	17.7181	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6122	17.8811	18.3667	19.0042	19.5258	19.8490	19.9470	19.9352	19.7216	19.0591	18.2394	17.5681	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8414	0.7296	0.5636	0.4006	0.4458	0.6804	0.8666	0.9378	0.9610	(94)
Useful gains	712.0004	770.6538	817.7740	832.2088	761.5200	575.8632	390.5889	406.5362	571.2762	657.0913	668.6588	683.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.2525	1610.9158	1468.9001	1235.8576	955.0294	633.8441	404.1700	426.0469	681.6128	1032.3103	1365.6152	1646.6284	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating												3683.4464	(98)
Space heating per m2											(98) / (4) =	33.9739	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4070.1065	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	776.2692	623.9293	535.2904	321.1349	159.0839	0.0000	0.0000	0.0000	0.0000	308.4673	554.4846	791.4469	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9081	89.9430	89.9784	90.0411	90.1080	87.3000	87.3000	87.3000	87.3000	89.6663	89.8193	89.9207	(217)
Fuel for water heating, kWh/month													
	171.0733	127.6221	101.1433	52.1301	21.5138	4.4162	0.0000	31.2800	57.4574	105.8110	145.6055	169.8636	(219)
Water heating fuel used												987.9163	(219)
Annual totals kWh/year													
Space heating fuel - main system												4070.1065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3924.3652	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4070.1065	3.4800	141.6397	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9163	3.4800	34.3795	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			146.4898	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4010 (257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.4057	
SAP rating (Section 12)	94	(258)
SAP band	A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4070.1065	0.2160	879.1430	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9163	0.2160	213.3899	(264)
Space and water heating			1092.5329	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			504.1646	(272)
CO2 emissions per m2			4.6500	(273)
EI value			95.5965	
EI rating			96	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house													

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

	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693 (89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating												3123.6617	(98)
Space heating per m2											(98) / (4) =	28.8108	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3451.5599	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	690.3134	557.0119	455.6046	249.8163	96.9078	0.0000	0.0000	0.0000	0.0000	231.6142	469.0232	701.2686	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8564	89.8844	89.8906	89.9282	89.8160	87.3000	87.3000	87.3000	87.3000	89.4947	89.7402	89.8662	(217)
Fuel for water heating, kWh/month													
	168.8328	128.8675	104.0933	52.7598	25.6071	0.0000	0.0000	25.5558	53.3022	103.4867	142.0569	168.2640	(219)
Water heating fuel used												972.8262	(219)
Annual totals kWh/year													
Space heating fuel - main system												3451.5599	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3193.8082	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3451.5599	3.9200	135.3011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	972.8262	3.9200	38.1348	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			52.7299	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

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

Space heating - main system 1	3451.5599	0.2160	745.5369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8262	0.2160	210.1304	(264)
Space and water heating			955.6674	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			316.9975	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3451.5599	1.2200	4210.9031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8262	1.2200	1186.8479	(264)
Space and water heating			5397.7510	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1619.8769	(272)
Primary energy kWh/m2/year			14.9408	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-308	**Issued on Date**	19/10/2022
Assessment Reference	Plot 308	**Prop Type Ref**	3T-Opp-SEMI
Property	Plot 308, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	15.81	**TER**	17.43
Environmental	86 B	**% DER<TER**	9.30		
CO_2 Emissions (t/year)	1.43	**DFEE**	46.15	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.53		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.81 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9891	0.9812	0.9638	0.9229	0.8434	0.7121	0.5698	0.6182	0.8195	0.9471	0.9826	0.9910	(86)
MIT	18.9389	19.1656	19.5502	20.0506	20.4926	20.8045	20.9315	20.9091	20.6636	20.0756	19.4177	18.9015	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9870	0.9775	0.9563	0.9056	0.8056	0.6385	0.4603	0.5111	0.7623	0.9319	0.9785	0.9892	(89)
MIT 2	17.1965	17.5275	18.0856	18.8070	19.4167	19.8171	19.9483	19.9322	19.6563	18.8551	17.9035	17.1476	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4356	17.7523	18.2866	18.9777	19.5643	19.9526	20.0833	20.0663	19.7946	19.0226	18.1113	17.3883	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2856	17.6023	18.1366	18.8277	19.4143	19.8026	19.9333	19.9163	19.6446	18.8726	17.9613	17.2383	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9780	0.9645	0.9371	0.8801	0.7802	0.6230	0.4536	0.5022	0.7388	0.9087	0.9660	0.9815	(94)
Useful gains	546.0195	630.4086	703.4650	744.9123	704.6559	550.7980	383.0349	396.2525	531.5838	565.3140	529.3678	516.1977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1615.6272	1576.3129	1440.4178	1214.2683	941.4290	628.2347	402.5055	423.7740	672.2670	1009.5518	1331.5194	1605.9986	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	795.7881	635.6477	548.2929	337.9363	176.1592	0.0000	0.0000	0.0000	0.0000	330.5129	577.5492	810.8119	(98)
Space heating												4212.6980	(98)
Space heating per m2											(98) / (4) =	38.8554	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4654.9149	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	795.7881	635.6477	548.2929	337.9363	176.1592	0.0000	0.0000	0.0000	0.0000	330.5129	577.5492	810.8119	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	879.3239	702.3731	605.8485	373.4103	194.6510	0.0000	0.0000	0.0000	0.0000	365.2076	638.1759	895.9247	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8944	89.8473	89.7458	89.5217	89.0617	87.3000	87.3000	87.3000	87.3000	89.4809	89.7830	89.9177	(217)
Fuel for water heating, kWh/month	199.3146	174.8662	181.7267	160.3485	155.7762	138.8278	130.3257	147.1641	148.2179	166.4984	179.1735	193.4745	(219)
Water heating fuel used												1975.7142	(219)
Annual totals kWh/year													
Space heating fuel - main system												4654.9149	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7174.2109	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4654.9149	0.2160	1005.4616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7142	0.2160	426.7543	(264)
Space and water heating			1432.2159	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1714.3348	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.8100	(273)

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

DER		15.8100	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.2455	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2455	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

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Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4895.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month													
	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	126.1377	125.7512	125.3723	123.5927	123.2597	121.7097	121.7097	121.4227	122.3068	123.2597	123.9333	124.6375	(39)
Average = Sum(39)m / 12 =												123.5911	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1634	1.1599	1.1564	1.1399	1.1369	1.1226	1.1226	1.1199	1.1281	1.1369	1.1431	1.1496	(40)
HLP (average)												1.1399	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1369	32.2357	32.3331	32.7987	32.8873	33.3061	33.3061	33.3848	33.1435	32.8873	32.7085	32.5237	
alpha	3.1425	3.1490	3.1555	3.1866	3.1925	3.2204	3.2204	3.2257	3.2096	3.1925	3.1806	3.1682	
util living area	0.9905	0.9832	0.9669	0.9282	0.8525	0.7248	0.5840	0.6343	0.8317	0.9523	0.9848	0.9922	(86)
MIT	18.8428	19.0754	19.4713	19.9916	20.4521	20.7844	20.9225	20.8971	20.6321	20.0175	19.3397	18.8100	(87)
Th 2	19.9494	19.9523	19.9551	19.9683	19.9708	19.9824	19.9824	19.9846	19.9780	19.9708	19.9658	19.9605	(88)
util rest of house	0.9886	0.9798	0.9600	0.9119	0.8160	0.6519	0.4731	0.5264	0.7765	0.9384	0.9812	0.9906	(89)
MIT 2	17.9709	18.2040	18.5979	19.1161	19.5529	19.8511	19.9501	19.9382	19.7292	19.1507	18.4781	17.9462	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0906	18.3236	18.7177	19.2363	19.6763	19.9792	20.0835	20.0698	19.8532	19.2697	18.5963	18.0647	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0906	18.3236	18.7177	19.2363	19.6763	19.9792	20.0835	20.0698	19.8532	19.2697	18.5963	18.0647	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8975	0.8037	0.6517	0.4850	0.5364	0.7685	0.9260	0.9745	0.9865	(94)
Useful gains	515.3278	603.0012	682.1779	733.1898	703.4324	559.3723	397.9330	409.1063	532.1607	548.6584	502.4535	485.6678	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1739.5086	1688.0364	1531.7653	1277.4892	983.1534	654.7047	423.9805	445.5932	703.6505	1068.6258	1424.7765	1728.0660	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	910.7906	729.1436	632.0930	391.8955	208.1125	0.0000	0.0000	0.0000	0.0000	386.8558	664.0725	924.3443	(98)
Space heating												4847.3078	(98)
Space heating per m2											(98) / (4) =	44.7086	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1144.0714	900.6520	922.8124	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7527	0.8233	0.7938	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	861.1882	741.5189	732.5250	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	181.9101	242.3751	200.5673	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												624.8525	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.4775	60.5938	50.1418	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.2131	(107)
Space cooling per m2												1.4408	(108)
Energy for space heating												44.7086	(99)
Energy for space cooling												1.4408	(108)
Total												46.1494	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3572	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659	(89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375 (98)
Space heating												3007.4150 (98)
RHI space heating demand												3007 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9729	0.9598	0.9338	0.8788	0.7836	0.6390	0.4959	0.5365	0.7401	0.9014	0.9595	0.9765	(86)
MIT	19.2133	19.4258	19.7786	20.2274	20.6064	20.8598	20.9545	20.9403	20.7601	20.2663	19.6636	19.1736	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9678	0.9524	0.9212	0.8547	0.7390	0.5638	0.3945	0.4353	0.6740	0.8767	0.9507	0.9721	(89)
MIT 2	17.5930	17.9006	18.4076	19.0455	19.5555	19.8705	19.9633	19.9544	19.7620	19.1136	18.2551	17.5415	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8154	18.1099	18.5958	19.2077	19.6997	20.0063	20.0994	20.0897	19.8990	19.2718	18.4484	17.7655	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6654	17.9599	18.4458	19.0577	19.5497	19.8563	19.9494	19.9397	19.7490	19.1218	18.2984	17.6155	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8968	0.8282	0.7173	0.5530	0.3903	0.4298	0.6562	0.8501	0.9306	0.9574	(94)
Useful gains	738.8137	809.9921	856.9441	858.8269	773.9095	579.8194	391.8671	409.0568	585.6329	688.0443	697.9737	707.7445	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1662.8785	1620.6964	1478.6897	1242.4007	957.9491	634.7165	404.4500	426.5991	684.9290	1039.9641	1372.8515	1652.4579	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating												3558.5821	(98)
Space heating per m2											(98) / (4) =	32.8222	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3932.1349	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.6732	601.9816	511.1368	305.1637	151.2989	0.0000	0.0000	0.0000	0.0000	289.3131	536.9194	776.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8194	89.7635	89.6435	89.3795	88.8607	87.3000	87.3000	87.3000	87.3000	89.3127	89.6824	89.8466	(217)
Fuel for water heating, kWh/month	199.4813	175.0294	181.9342	160.6036	156.1286	138.8278	130.3257	147.1641	148.2179	166.8119	179.3746	193.6277	(219)
Water heating fuel used												1977.5268	(219)
Annual totals kWh/year													
Space heating fuel - main system												3932.1349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6453.2434	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3932.1349	3.4800	136.8383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.5268	3.4800	68.8179	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			397.3547	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0878	(257)
SAP value		84.8253	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3932.1349	0.2160	849.3411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.5268	0.2160	427.1458	(264)
Space and water heating			1276.4869	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1558.6058	(272)
CO2 emissions per m2			14.3800	(273)
EI value			86.3868	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659	(89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804	(97)

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

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating												3007.4150	(98)
Space heating per m2											(98) / (4) =	27.7386	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3323.1104	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	672.8440	536.3996	434.1839	236.6342	91.9352	0.0000	0.0000	0.0000	0.0000	214.6706	450.6556	685.7873	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7520	89.6961	89.5373	89.1881	88.4728	87.3000	87.3000	87.3000	87.3000	89.0828	89.5713	89.7795	(217)
Fuel for water heating, kWh/month													
	199.6309	175.1610	182.1499	160.9483	156.8132	138.8278	130.3257	147.1641	148.2179	167.2425	179.5971	193.7724	(219)
Water heating fuel used												1979.8508	(219)
Annual totals kWh/year													
Space heating fuel - main system												3323.1104	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5846.5430	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3323.1104	3.9200	130.2659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.8508	3.9200	77.6102	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			388.0675	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3323.1104	0.2160	717.7919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8508	0.2160	427.6478	(264)
Space and water heating			1145.4396	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1427.5585	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3323.1104	1.2200	4054.1947	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8508	1.2200	2415.4179	(264)
Space and water heating			6469.6127	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8138.4086	(272)
Primary energy kWh/m2/year			75.0637	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-192 kg (13.4%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (76.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 95	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£296	£256	£39
Space heating	£231	£231	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£388	£48	£340
Total cost of uses	£388	£48	£340
Delivered energy	54 kWh/m²	28 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	13 kWh/m²	62 kWh/m²

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9729	0.9598	0.9338	0.8788	0.7836	0.6390	0.4959	0.5365	0.7401	0.9014	0.9595	0.9765	(86)
MIT	19.2133	19.4258	19.7786	20.2274	20.6064	20.8598	20.9545	20.9403	20.7601	20.2663	19.6636	19.1736	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9678	0.9524	0.9212	0.8547	0.7390	0.5638	0.3945	0.4353	0.6740	0.8767	0.9507	0.9721	(89)
MIT 2	17.5930	17.9006	18.4076	19.0455	19.5555	19.8705	19.9633	19.9544	19.7620	19.1136	18.2551	17.5415	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8154	18.1099	18.5958	19.2077	19.6997	20.0063	20.0994	20.0897	19.8990	19.2718	18.4484	17.7655	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6654	17.9599	18.4458	19.0577	19.5497	19.8563	19.9494	19.9397	19.7490	19.1218	18.2984	17.6155	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8968	0.8282	0.7173	0.5530	0.3903	0.4298	0.6562	0.8501	0.9306	0.9574	(94)
Useful gains	738.8137	809.9921	856.9441	858.8269	773.9095	579.8194	391.8671	409.0568	585.6329	688.0443	697.9737	707.7445	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1662.8785	1620.6964	1478.6897	1242.4007	957.9491	634.7165	404.4500	426.5991	684.9290	1039.9641	1372.8515	1652.4579	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating												3558.5821	(98)
Space heating per m2											(98) / (4) =	32.8222	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3932.1349	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.6732	601.9816	511.1368	305.1637	151.2989	0.0000	0.0000	0.0000	0.0000	289.3131	536.9194	776.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8976	89.9263	89.9579	90.0206	90.0905	87.3000	87.3000	87.3000	87.3000	89.6262	89.8019	89.9116	(217)
Fuel for water heating, kWh/month	171.0932	127.6457	101.1663	52.1419	21.5180	4.4162	0.0000	31.2800	57.4574	105.8584	145.6337	169.8806	(219)
Water heating fuel used												988.0916	(219)
Annual totals kWh/year													
Space heating fuel - main system												3932.1349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3786.5688	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3932.1349	3.4800	136.8383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.0916	3.4800	34.3856	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			141.6944	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.3879	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.5888	
SAP rating (Section 12)	95	(258)
SAP band	A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3932.1349	0.2160	849.3411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.0916	0.2160	213.4278	(264)
Space and water heating			1062.7689	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			474.4006	(272)
CO2 emissions per m2			4.3800	(273)
EI value			95.8565	
EI rating			96	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house													

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

	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659 (89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating												3007.4150	(98)
Space heating per m2											(98) / (4) =	27.7386	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3323.1104	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	672.8440	536.3996	434.1839	236.6342	91.9352	0.0000	0.0000	0.0000	0.0000	214.6706	450.6556	685.7873	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8432	89.8654	89.8664	89.9023	89.7872	87.3000	87.3000	87.3000	87.3000	89.4416	89.7169	89.8547	(217)
Fuel for water heating, kWh/month	168.8578	128.8947	104.1213	52.7750	25.6153	0.0000	0.0000	25.5558	53.3022	103.5482	142.0939	168.2854	(219)
Water heating fuel used												973.0495	(219)
Annual totals kWh/year													
Space heating fuel - main system												3323.1104	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3065.5820	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3323.1104	3.9200	130.2659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.0495	3.9200	38.1435	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			47.7035	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

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

Space heating - main system 1	3323.1104	0.2160	717.7919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0495	0.2160	210.1787	(264)
Space and water heating			927.9705	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			289.3006	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3323.1104	1.2200	4054.1947	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0495	1.2200	1187.1204	(264)
Space and water heating			5241.3151	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1463.4410	(272)
Primary energy kWh/m2/year			13.4979	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						639.6507

	Jun	Jul	Aug	
Solar gains	676	640	575	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1183	1125	1070	(P5)
Summer gain/loss ratio	2.68	2.55	2.43	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.73	21.49	21.27	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-309	**Issued on Date**	19/10/2022
Assessment Reference	Plot 309	**Prop Type Ref**	3T-As-SEMI
Property	Plot 309, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	16.13	**TER**	17.77
Environmental	86 B	**% DER<TER**	9.24		
CO_2 Emissions (t/year)	1.46	**DFEE**	47.53	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.70		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.13 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.5 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

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

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9908	0.9849	0.9704	0.9329	0.8552	0.7247	0.5851	0.6410	0.8438	0.9575	0.9857	0.9923	(86)
MIT	18.8978	19.1033	19.4845	20.0013	20.4662	20.7934	20.9259	20.8987	20.6267	20.0178	19.3705	18.8653	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9889	0.9818	0.9641	0.9173	0.8191	0.6519	0.4744	0.5331	0.7907	0.9448	0.9823	0.9908	(89)
MIT 2	17.1369	17.4374	17.9919	18.7393	19.3836	19.8059	19.9445	19.9244	19.6139	18.7749	17.8353	17.0949	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.3785	17.6661	18.1967	18.9125	19.5322	19.9414	20.0792	20.0581	19.7529	18.9455	18.0460	17.3379	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2285	17.5161	18.0467	18.7625	19.3822	19.7914	19.9292	19.9081	19.6029	18.7955	17.8960	17.1879	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8927	0.7932	0.6355	0.4671	0.5231	0.7657	0.9234	0.9713	0.9839	(94)
Useful gains	516.7022	586.6338	658.5678	712.7909	688.4699	544.8594	380.8218	391.8394	510.5142	527.3126	496.3366	490.3204	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1608.5246	1565.6119	1429.2942	1206.2987	937.5059	626.8857	402.0146	422.7886	667.2143	1000.1435	1323.5166	1599.7927	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	812.3158	657.8733	573.4204	355.3256	185.2828	0.0000	0.0000	0.0000	0.0000	351.7862	595.5696	825.4474	(98)
Space heating												4357.0212	(98)
Space heating per m2											(98) / (4) =	40.1865	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4814.3881	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	812.3158	657.8733	573.4204	355.3256	185.2828	0.0000	0.0000	0.0000	0.0000	351.7862	595.5696	825.4474	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	897.5865	726.9318	633.6137	392.6250	204.7324	0.0000	0.0000	0.0000	0.0000	388.7140	658.0880	912.0966	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9045	89.8650	89.7713	89.5554	89.1016	87.3000	87.3000	87.3000	87.3000	89.5237	89.8000	89.9262	(217)
Fuel for water heating, kWh/month													
	199.2924	174.8318	181.6751	160.2881	155.7065	138.8278	130.3257	147.1641	148.2179	166.4188	179.1397	193.4562	(219)
Water heating fuel used												1975.3441	(219)
Annual totals kWh/year													
Space heating fuel - main system												4814.3881	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7333.3139	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4814.3881	0.2160	1039.9078	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.3441	0.2160	426.6743	(264)
Space and water heating			1466.5822	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1748.7011	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.1300	(273)

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

DER		16.1300	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.5655	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.5655	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
										Total per year (kWh/year) = Sum(64)m =		2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	126.1377	125.7512	125.3723	123.5927	123.2597	121.7097	121.7097	121.4227	122.3068	123.2597	123.9333	124.6375	(39)
Average = Sum(39)m / 12 =												123.5911	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1634	1.1599	1.1564	1.1399	1.1369	1.1226	1.1226	1.1199	1.1281	1.1369	1.1431	1.1496	(40)
HLP (average)												1.1399	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1369	32.2357	32.3331	32.7987	32.8873	33.3061	33.3061	33.3848	33.1435	32.8873	32.7085	32.5237	
alpha	3.1425	3.1490	3.1555	3.1866	3.1925	3.2204	3.2204	3.2257	3.2096	3.1925	3.1806	3.1682	
util living area	0.9920	0.9866	0.9732	0.9378	0.8640	0.7375	0.5997	0.6575	0.8556	0.9621	0.9877	0.9934	(86)
MIT	18.8013	19.0123	19.4043	19.9409	20.4243	20.7723	20.9162	20.8854	20.5928	19.9581	19.2917	18.7734	(87)
Th 2	19.9494	19.9523	19.9551	19.9683	19.9708	19.9824	19.9824	19.9846	19.9780	19.9708	19.9658	19.9605	(88)
util rest of house	0.9904	0.9839	0.9674	0.9233	0.8293	0.6656	0.4877	0.5493	0.8049	0.9506	0.9847	0.9920	(89)
MIT 2	17.9297	18.1416	18.5325	19.0683	19.5289	19.8427	19.9471	19.9320	19.6979	19.0942	18.4307	17.9098	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0493	18.2611	18.6522	19.1881	19.6518	19.9703	20.0801	20.0629	19.8207	19.2127	18.5489	18.0283	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0493	18.2611	18.6522	19.1881	19.6518	19.9703	20.0801	20.0629	19.8207	19.2127	18.5489	18.0283	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9777	0.9577	0.9094	0.8165	0.6646	0.4995	0.5586	0.7955	0.9393	0.9789	0.9885	(94)
Useful gains	485.4403	558.0760	635.5838	699.3080	685.9638	552.6799	395.2349	403.7675	508.7925	508.5729	468.5030	459.3457	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1734.3044	1680.1755	1523.5459	1271.5289	980.1386	653.6208	423.5619	444.7569	699.6796	1061.6039	1418.8999	1723.5286	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	929.1549	754.0509	660.6438	411.9990	218.8660	0.0000	0.0000	0.0000	0.0000	411.4551	684.2858	940.5521	(98)
Space heating												5011.0075	(98)
Space heating per m2											(98) / (4) =	46.2185	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1144.0714	900.6520	922.8124	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7416	0.8125	0.7764	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	848.4069	731.8142	716.5005	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	168.6108	224.2339	177.7604	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												570.6051	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.1527	56.0585	44.4401	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.6513	(107)
Space cooling per m2												1.3157	(108)
Energy for space heating												46.2185	(99)
Energy for space cooling												1.3157	(108)
Total												47.5342	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)	
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)	
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)	
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												332.3747 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												83.0937 (107)
Space cooling per m2												0.7664 (108)
Energy for space heating												47.6900 (99)
Energy for space cooling												0.7664 (108)
Total												48.4564 (109)
Target Fabric Energy Efficiency (TFEE)												55.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3572	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693	(89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480 (98)
Space heating												3123.6617 (98)
RHI space heating demand												3124 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9757	0.9655	0.9427	0.8904	0.7956	0.6503	0.5082	0.5550	0.7641	0.9149	0.9645	0.9788	(86)
MIT	19.1746	19.3681	19.7198	20.1858	20.5859	20.8522	20.9511	20.9341	20.7342	20.2177	19.6203	19.1393	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9712	0.9590	0.9315	0.8680	0.7521	0.5751	0.4052	0.4520	0.6999	0.8928	0.9567	0.9748	(89)
MIT 2	17.5375	17.8184	18.3253	18.9901	19.5310	19.8633	19.9612	19.9501	19.7344	19.0486	18.1936	17.4921	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7622	18.0311	18.5167	19.1542	19.6758	19.9990	20.0970	20.0852	19.8716	19.2091	18.3894	17.7181	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6122	17.8811	18.3667	19.0042	19.5258	19.8490	19.9470	19.9352	19.7216	19.0591	18.2394	17.5681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8414	0.7296	0.5636	0.4006	0.4458	0.6804	0.8666	0.9378	0.9610	(94)
Useful gains	712.0004	770.6538	817.7740	832.2088	761.5200	575.8632	390.5889	406.5362	571.2762	657.0913	668.6588	683.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.2525	1610.9158	1468.9001	1235.8576	955.0294	633.8441	404.1700	426.0469	681.6128	1032.3103	1365.6152	1646.6284	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating												3683.4464	(98)
Space heating per m2											(98) / (4) =	33.9739	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4070.1065	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	776.2692	623.9293	535.2904	321.1349	159.0839	0.0000	0.0000	0.0000	0.0000	308.4673	554.4846	791.4469	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8309	89.7836	89.6721	89.4164	88.9008	87.3000	87.3000	87.3000	87.3000	89.3602	89.7018	89.8563	(217)
Fuel for water heating, kWh/month	199.4557	174.9902	181.8761	160.5374	156.0581	138.8278	130.3257	147.1641	148.2179	166.7233	179.3357	193.6067	(219)
Water heating fuel used												1977.1187	(219)
Annual totals kWh/year													
Space heating fuel - main system												4070.1065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6590.8070	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4070.1065	3.4800	141.6397	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.1187	3.4800	68.8037	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			402.1419	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1009	(257)
SAP value		84.6425	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4070.1065	0.2160	879.1430	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.1187	0.2160	427.0576	(264)
Space and water heating			1306.2007	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1588.3196	(272)
CO2 emissions per m2			14.6500	(273)
EI value			86.1273	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693	(89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568	(97)

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

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating												3123.6617	(98)
Space heating per m2											(98) / (4) =	28.8108	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3451.5599	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	690.3134	557.0119	455.6046	249.8163	96.9078	0.0000	0.0000	0.0000	0.0000	231.6142	469.0232	701.2686	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7666	89.7186	89.5694	89.2298	88.5122	87.3000	87.3000	87.3000	87.3000	89.1424	89.5974	89.7919	(217)
Fuel for water heating, kWh/month	199.5984	175.1171	182.0846	160.8730	156.7434	138.8278	130.3257	147.1641	148.2179	167.1306	179.5447	193.7456	(219)
Water heating fuel used												1979.3730	(219)
Annual totals kWh/year													
Space heating fuel - main system												3451.5599	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5974.5147	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3451.5599	3.9200	135.3011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3730	3.9200	77.5914	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			393.0840	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3451.5599	0.2160	745.5369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3730	0.2160	427.5446	(264)
Space and water heating			1173.0815	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1455.2004	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3451.5599	1.2200	4210.9031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3730	1.2200	2414.8350	(264)
Space and water heating			6625.7382	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8294.5341	(272)
Primary energy kWh/m2/year			76.5037	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-191 kg (13.2%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (74.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 94	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£301	£261	£39
Space heating	£236	£236	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£393	£53	£340
Total cost of uses	£393	£53	£340
Delivered energy	55 kWh/m²	29 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	15 kWh/m²	62 kWh/m²

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9757	0.9655	0.9427	0.8904	0.7956	0.6503	0.5082	0.5550	0.7641	0.9149	0.9645	0.9788	(86)
MIT	19.1746	19.3681	19.7198	20.1858	20.5859	20.8522	20.9511	20.9341	20.7342	20.2177	19.6203	19.1393	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9712	0.9590	0.9315	0.8680	0.7521	0.5751	0.4052	0.4520	0.6999	0.8928	0.9567	0.9748	(89)
MIT 2	17.5375	17.8184	18.3253	18.9901	19.5310	19.8633	19.9612	19.9501	19.7344	19.0486	18.1936	17.4921	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7622	18.0311	18.5167	19.1542	19.6758	19.9990	20.0970	20.0852	19.8716	19.2091	18.3894	17.7181	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6122	17.8811	18.3667	19.0042	19.5258	19.8490	19.9470	19.9352	19.7216	19.0591	18.2394	17.5681	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8414	0.7296	0.5636	0.4006	0.4458	0.6804	0.8666	0.9378	0.9610	(94)
Useful gains	712.0004	770.6538	817.7740	832.2088	761.5200	575.8632	390.5889	406.5362	571.2762	657.0913	668.6588	683.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.2525	1610.9158	1468.9001	1235.8576	955.0294	633.8441	404.1700	426.0469	681.6128	1032.3103	1365.6152	1646.6284	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating												3683.4464	(98)
Space heating per m2											(98) / (4) =	33.9739	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4070.1065	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	776.2692	623.9293	535.2904	321.1349	159.0839	0.0000	0.0000	0.0000	0.0000	308.4673	554.4846	791.4469	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9081	89.9430	89.9784	90.0411	90.1080	87.3000	87.3000	87.3000	87.3000	89.6663	89.8193	89.9207	(217)
Fuel for water heating, kWh/month													
	171.0733	127.6221	101.1433	52.1301	21.5138	4.4162	0.0000	31.2800	57.4574	105.8110	145.6055	169.8636	(219)
Water heating fuel used												987.9163	(219)
Annual totals kWh/year													
Space heating fuel - main system												4070.1065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3924.3652	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4070.1065	3.4800	141.6397	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9163	3.4800	34.3795	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			146.4898	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4010 (257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.4057	
SAP rating (Section 12)	94	(258)
SAP band	A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4070.1065	0.2160	879.1430	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9163	0.2160	213.3899	(264)
Space and water heating			1092.5329	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			504.1646	(272)
CO2 emissions per m2			4.6500	(273)
EI value			95.5965	
EI rating			96	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house													

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

	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693 (89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating												3123.6617	(98)
Space heating per m2											(98) / (4) =	28.8108	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3451.5599	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	690.3134	557.0119	455.6046	249.8163	96.9078	0.0000	0.0000	0.0000	0.0000	231.6142	469.0232	701.2686	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8564	89.8844	89.8906	89.9282	89.8160	87.3000	87.3000	87.3000	87.3000	89.4947	89.7402	89.8662	(217)
Fuel for water heating, kWh/month													
	168.8328	128.8675	104.0933	52.7598	25.6071	0.0000	0.0000	25.5558	53.3022	103.4867	142.0569	168.2640	(219)
Water heating fuel used												972.8262	(219)
Annual totals kWh/year													
Space heating fuel - main system												3451.5599	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3193.8082	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3451.5599	3.9200	135.3011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	972.8262	3.9200	38.1348	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			52.7299	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

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

Space heating - main system 1	3451.5599	0.2160	745.5369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8262	0.2160	210.1304	(264)
Space and water heating			955.6674	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			316.9975	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3451.5599	1.2200	4210.9031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8262	1.2200	1186.8479	(264)
Space and water heating			5397.7510	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1619.8769	(272)
Primary energy kWh/m2/year			14.9408	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

AES Sustainability Consultants

Property Reference	4907-P637-6633-310	**Issued on Date**	19/10/2022
Assessment Reference	Plot 310	**Prop Type Ref**	3T-Opp-SEMI
Property	Plot 310, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	15.81	**TER**	17.43
Environmental	86 B	**% DER<TER**	9.30		
CO_2 Emissions (t/year)	1.43	**DFEE**	46.15	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.53		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.81 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9891	0.9812	0.9638	0.9229	0.8434	0.7121	0.5698	0.6182	0.8195	0.9471	0.9826	0.9910	(86)
MIT	18.9389	19.1656	19.5502	20.0506	20.4926	20.8045	20.9315	20.9091	20.6636	20.0756	19.4177	18.9015	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9870	0.9775	0.9563	0.9056	0.8056	0.6385	0.4603	0.5111	0.7623	0.9319	0.9785	0.9892	(89)
MIT 2	17.1965	17.5275	18.0856	18.8070	19.4167	19.8171	19.9483	19.9322	19.6563	18.8551	17.9035	17.1476	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4356	17.7523	18.2866	18.9777	19.5643	19.9526	20.0833	20.0663	19.7946	19.0226	18.1113	17.3883	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2856	17.6023	18.1366	18.8277	19.4143	19.8026	19.9333	19.9163	19.6446	18.8726	17.9613	17.2383	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9780	0.9645	0.9371	0.8801	0.7802	0.6230	0.4536	0.5022	0.7388	0.9087	0.9660	0.9815	(94)
Useful gains	546.0195	630.4086	703.4650	744.9123	704.6559	550.7980	383.0349	396.2525	531.5838	565.3140	529.3678	516.1977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1615.6272	1576.3129	1440.4178	1214.2683	941.4290	628.2347	402.5055	423.7740	672.2670	1009.5518	1331.5194	1605.9986	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	795.7881	635.6477	548.2929	337.9363	176.1592	0.0000	0.0000	0.0000	0.0000	330.5129	577.5492	810.8119	(98)
Space heating												4212.6980	(98)
Space heating per m2											(98) / (4) =	38.8554	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4654.9149	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	795.7881	635.6477	548.2929	337.9363	176.1592	0.0000	0.0000	0.0000	0.0000	330.5129	577.5492	810.8119	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	879.3239	702.3731	605.8485	373.4103	194.6510	0.0000	0.0000	0.0000	0.0000	365.2076	638.1759	895.9247	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8944	89.8473	89.7458	89.5217	89.0617	87.3000	87.3000	87.3000	87.3000	89.4809	89.7830	89.9177	(217)
Fuel for water heating, kWh/month	199.3146	174.8662	181.7267	160.3485	155.7762	138.8278	130.3257	147.1641	148.2179	166.4984	179.1735	193.4745	(219)
Water heating fuel used												1975.7142	(219)
Annual totals kWh/year													
Space heating fuel - main system												4654.9149	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7174.2109	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4654.9149	0.2160	1005.4616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7142	0.2160	426.7543	(264)
Space and water heating			1432.2159	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1714.3348	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.8100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.8100	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.2455	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2455	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4895.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month													
	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	126.1377	125.7512	125.3723	123.5927	123.2597	121.7097	121.7097	121.4227	122.3068	123.2597	123.9333	124.6375	(39)
Average = Sum(39)m / 12 =												123.5911	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1634	1.1599	1.1564	1.1399	1.1369	1.1226	1.1226	1.1199	1.1281	1.1369	1.1431	1.1496	(40)
HLP (average)												1.1399	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1369	32.2357	32.3331	32.7987	32.8873	33.3061	33.3061	33.3848	33.1435	32.8873	32.7085	32.5237	
alpha	3.1425	3.1490	3.1555	3.1866	3.1925	3.2204	3.2204	3.2257	3.2096	3.1925	3.1806	3.1682	
util living area	0.9905	0.9832	0.9669	0.9282	0.8525	0.7248	0.5840	0.6343	0.8317	0.9523	0.9848	0.9922	(86)
MIT	18.8428	19.0754	19.4713	19.9916	20.4521	20.7844	20.9225	20.8971	20.6321	20.0175	19.3397	18.8100	(87)
Th 2	19.9494	19.9523	19.9551	19.9683	19.9708	19.9824	19.9824	19.9846	19.9780	19.9708	19.9658	19.9605	(88)
util rest of house	0.9886	0.9798	0.9600	0.9119	0.8160	0.6519	0.4731	0.5264	0.7765	0.9384	0.9812	0.9906	(89)
MIT 2	17.9709	18.2040	18.5979	19.1161	19.5529	19.8511	19.9501	19.9382	19.7292	19.1507	18.4781	17.9462	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0906	18.3236	18.7177	19.2363	19.6763	19.9792	20.0835	20.0698	19.8532	19.2697	18.5963	18.0647	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0906	18.3236	18.7177	19.2363	19.6763	19.9792	20.0835	20.0698	19.8532	19.2697	18.5963	18.0647	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8975	0.8037	0.6517	0.4850	0.5364	0.7685	0.9260	0.9745	0.9865	(94)
Useful gains	515.3278	603.0012	682.1779	733.1898	703.4324	559.3723	397.9330	409.1063	532.1607	548.6584	502.4535	485.6678	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1739.5086	1688.0364	1531.7653	1277.4892	983.1534	654.7047	423.9805	445.5932	703.6505	1068.6258	1424.7765	1728.0660	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	910.7906	729.1436	632.0930	391.8955	208.1125	0.0000	0.0000	0.0000	0.0000	386.8558	664.0725	924.3443	(98)
Space heating												4847.3078	(98)
Space heating per m2											(98) / (4) =	44.7086	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1144.0714	900.6520	922.8124	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7527	0.8233	0.7938	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	861.1882	741.5189	732.5250	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	181.9101	242.3751	200.5673	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												624.8525	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.4775	60.5938	50.1418	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.2131	(107)
Space cooling per m2												1.4408	(108)
Energy for space heating												44.7086	(99)
Energy for space cooling												1.4408	(108)
Total												46.1494	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3572	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659	(89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375 (98)
Space heating												3007.4150 (98)
RHI space heating demand												3007 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9729	0.9598	0.9338	0.8788	0.7836	0.6390	0.4959	0.5365	0.7401	0.9014	0.9595	0.9765	(86)
MIT	19.2133	19.4258	19.7786	20.2274	20.6064	20.8598	20.9545	20.9403	20.7601	20.2663	19.6636	19.1736	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9678	0.9524	0.9212	0.8547	0.7390	0.5638	0.3945	0.4353	0.6740	0.8767	0.9507	0.9721	(89)
MIT 2	17.5930	17.9006	18.4076	19.0455	19.5555	19.8705	19.9633	19.9544	19.7620	19.1136	18.2551	17.5415	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8154	18.1099	18.5958	19.2077	19.6997	20.0063	20.0994	20.0897	19.8990	19.2718	18.4484	17.7655	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6654	17.9599	18.4458	19.0577	19.5497	19.8563	19.9494	19.9397	19.7490	19.1218	18.2984	17.6155	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8968	0.8282	0.7173	0.5530	0.3903	0.4298	0.6562	0.8501	0.9306	0.9574	(94)
Useful gains	738.8137	809.9921	856.9441	858.8269	773.9095	579.8194	391.8671	409.0568	585.6329	688.0443	697.9737	707.7445	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1662.8785	1620.6964	1478.6897	1242.4007	957.9491	634.7165	404.4500	426.5991	684.9290	1039.9641	1372.8515	1652.4579	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating												3558.5821	(98)
Space heating per m2											(98) / (4) =	32.8222	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3932.1349	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.6732	601.9816	511.1368	305.1637	151.2989	0.0000	0.0000	0.0000	0.0000	289.3131	536.9194	776.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8194	89.7635	89.6435	89.3795	88.8607	87.3000	87.3000	87.3000	87.3000	89.3127	89.6824	89.8466	(217)
Fuel for water heating, kWh/month	199.4813	175.0294	181.9342	160.6036	156.1286	138.8278	130.3257	147.1641	148.2179	166.8119	179.3746	193.6277	(219)
Water heating fuel used												1977.5268	(219)
Annual totals kWh/year													
Space heating fuel - main system												3932.1349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6453.2434	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3932.1349	3.4800	136.8383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.5268	3.4800	68.8179	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			397.3547	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0878	(257)
SAP value		84.8253	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3932.1349	0.2160	849.3411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.5268	0.2160	427.1458	(264)
Space and water heating			1276.4869	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1558.6058	(272)
CO2 emissions per m2			14.3800	(273)
EI value			86.3868	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659	(89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating												3007.4150	(98)
Space heating per m2											(98) / (4) =	27.7386	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3323.1104	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	672.8440	536.3996	434.1839	236.6342	91.9352	0.0000	0.0000	0.0000	0.0000	214.6706	450.6556	685.7873	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7520	89.6961	89.5373	89.1881	88.4728	87.3000	87.3000	87.3000	87.3000	89.0828	89.5713	89.7795	(217)
Fuel for water heating, kWh/month													
	199.6309	175.1610	182.1499	160.9483	156.8132	138.8278	130.3257	147.1641	148.2179	167.2425	179.5971	193.7724	(219)
Water heating fuel used												1979.8508	(219)
Annual totals kWh/year													
Space heating fuel - main system												3323.1104	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5846.5430	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3323.1104	3.9200	130.2659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.8508	3.9200	77.6102	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			388.0675	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3323.1104	0.2160	717.7919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8508	0.2160	427.6478	(264)
Space and water heating			1145.4396	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1427.5585	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3323.1104	1.2200	4054.1947	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8508	1.2200	2415.4179	(264)
Space and water heating			6469.6127	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8138.4086	(272)
Primary energy kWh/m2/year			75.0637	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-192 kg (13.4%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (76.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 95	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£296	£256	£39
Space heating	£231	£231	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£388	£48	£340
Total cost of uses	£388	£48	£340
Delivered energy	54 kWh/m²	28 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	13 kWh/m²	62 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9729	0.9598	0.9338	0.8788	0.7836	0.6390	0.4959	0.5365	0.7401	0.9014	0.9595	0.9765	(86)
MIT	19.2133	19.4258	19.7786	20.2274	20.6064	20.8598	20.9545	20.9403	20.7601	20.2663	19.6636	19.1736	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9678	0.9524	0.9212	0.8547	0.7390	0.5638	0.3945	0.4353	0.6740	0.8767	0.9507	0.9721	(89)
MIT 2	17.5930	17.9006	18.4076	19.0455	19.5555	19.8705	19.9633	19.9544	19.7620	19.1136	18.2551	17.5415	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8154	18.1099	18.5958	19.2077	19.6997	20.0063	20.0994	20.0897	19.8990	19.2718	18.4484	17.7655	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6654	17.9599	18.4458	19.0577	19.5497	19.8563	19.9494	19.9397	19.7490	19.1218	18.2984	17.6155	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8968	0.8282	0.7173	0.5530	0.3903	0.4298	0.6562	0.8501	0.9306	0.9574	(94)
Useful gains	738.8137	809.9921	856.9441	858.8269	773.9095	579.8194	391.8671	409.0568	585.6329	688.0443	697.9737	707.7445	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1662.8785	1620.6964	1478.6897	1242.4007	957.9491	634.7165	404.4500	426.5991	684.9290	1039.9641	1372.8515	1652.4579	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating												3558.5821	(98)
Space heating per m2											(98) / (4) =	32.8222	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3932.1349	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.6732	601.9816	511.1368	305.1637	151.2989	0.0000	0.0000	0.0000	0.0000	289.3131	536.9194	776.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8976	89.9263	89.9579	90.0206	90.0905	87.3000	87.3000	87.3000	87.3000	89.6262	89.8019	89.9116	(217)
Fuel for water heating, kWh/month	171.0932	127.6457	101.1663	52.1419	21.5180	4.4162	0.0000	31.2800	57.4574	105.8584	145.6337	169.8806	(219)
Water heating fuel used												988.0916	(219)
Annual totals kWh/year													
Space heating fuel - main system												3932.1349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3786.5688	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3932.1349	3.4800	136.8383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.0916	3.4800	34.3856	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			141.6944	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.3879	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.5888	
SAP rating (Section 12)	95	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3932.1349	0.2160	849.3411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.0916	0.2160	213.4278	(264)
Space and water heating			1062.7689	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			474.4006	(272)
CO2 emissions per m2			4.3800	(273)
EI value			95.8565	
EI rating			96	(274)
EI band			A	

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659 (89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating												3007.4150	(98)
Space heating per m2											(98) / (4) =	27.7386	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3323.1104	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	672.8440	536.3996	434.1839	236.6342	91.9352	0.0000	0.0000	0.0000	0.0000	214.6706	450.6556	685.7873	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8432	89.8654	89.8664	89.9023	89.7872	87.3000	87.3000	87.3000	87.3000	89.4416	89.7169	89.8547	(217)
Fuel for water heating, kWh/month	168.8578	128.8947	104.1213	52.7750	25.6153	0.0000	0.0000	25.5558	53.3022	103.5482	142.0939	168.2854	(219)
Water heating fuel used												973.0495	(219)
Annual totals kWh/year													
Space heating fuel - main system												3323.1104	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3065.5820	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3323.1104	3.9200	130.2659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.0495	3.9200	38.1435	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			47.7035	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3323.1104	0.2160	717.7919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0495	0.2160	210.1787	(264)
Space and water heating			927.9705	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			289.3006	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3323.1104	1.2200	4054.1947	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0495	1.2200	1187.1204	(264)
Space and water heating			5241.3151	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1463.4410	(272)
Primary energy kWh/m2/year			13.4979	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						639.6507

	Jun	Jul	Aug	
Solar gains	676	640	575	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1183	1125	1070	(P5)
Summer gain/loss ratio	2.68	2.55	2.43	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.73	21.49	21.27	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-311	**Issued on Date**	19/10/2022
Assessment Reference	Plot 311	**Prop Type Ref**	3T-As-SEMI
Property	Plot 311, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	16.13	**TER**	17.77
Environmental	86 B	**% DER<TER**	9.24		
CO_2 Emissions (t/year)	1.46	**DFEE**	47.53	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.70		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.13 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.5 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9908	0.9849	0.9704	0.9329	0.8552	0.7247	0.5851	0.6410	0.8438	0.9575	0.9857	0.9923	(86)
MIT	18.8978	19.1033	19.4845	20.0013	20.4662	20.7934	20.9259	20.8987	20.6267	20.0178	19.3705	18.8653	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9889	0.9818	0.9641	0.9173	0.8191	0.6519	0.4744	0.5331	0.7907	0.9448	0.9823	0.9908	(89)
MIT 2	17.1369	17.4374	17.9919	18.7393	19.3836	19.8059	19.9445	19.9244	19.6139	18.7749	17.8353	17.0949	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.3785	17.6661	18.1967	18.9125	19.5322	19.9414	20.0792	20.0581	19.7529	18.9455	18.0460	17.3379	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2285	17.5161	18.0467	18.7625	19.3822	19.7914	19.9292	19.9081	19.6029	18.7955	17.8960	17.1879	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8927	0.7932	0.6355	0.4671	0.5231	0.7657	0.9234	0.9713	0.9839	(94)
Useful gains	516.7022	586.6338	658.5678	712.7909	688.4699	544.8594	380.8218	391.8394	510.5142	527.3126	496.3366	490.3204	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1608.5246	1565.6119	1429.2942	1206.2987	937.5059	626.8857	402.0146	422.7886	667.2143	1000.1435	1323.5166	1599.7927	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	812.3158	657.8733	573.4204	355.3256	185.2828	0.0000	0.0000	0.0000	0.0000	351.7862	595.5696	825.4474	(98)
Space heating												4357.0212	(98)
Space heating per m2											(98) / (4) =	40.1865	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4814.3881	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	812.3158	657.8733	573.4204	355.3256	185.2828	0.0000	0.0000	0.0000	0.0000	351.7862	595.5696	825.4474	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	897.5865	726.9318	633.6137	392.6250	204.7324	0.0000	0.0000	0.0000	0.0000	388.7140	658.0880	912.0966	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9045	89.8650	89.7713	89.5554	89.1016	87.3000	87.3000	87.3000	87.3000	89.5237	89.8000	89.9262	(217)
Fuel for water heating, kWh/month													
	199.2924	174.8318	181.6751	160.2881	155.7065	138.8278	130.3257	147.1641	148.2179	166.4188	179.1397	193.4562	(219)
Water heating fuel used												1975.3441	(219)
Annual totals kWh/year													
Space heating fuel - main system												4814.3881	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7333.3139	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4814.3881	0.2160	1039.9078	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.3441	0.2160	426.6743	(264)
Space and water heating			1466.5822	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1748.7011	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.1300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.1300	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.5655	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.5655	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
										Total per year (kWh/year) = Sum(64)m =		2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	126.1377	125.7512	125.3723	123.5927	123.2597	121.7097	121.7097	121.4227	122.3068	123.2597	123.9333	124.6375	(39)
Average = Sum(39)m / 12 =												123.5911	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1634	1.1599	1.1564	1.1399	1.1369	1.1226	1.1226	1.1199	1.1281	1.1369	1.1431	1.1496	(40)
HLP (average)												1.1399	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1369	32.2357	32.3331	32.7987	32.8873	33.3061	33.3061	33.3848	33.1435	32.8873	32.7085	32.5237	
alpha	3.1425	3.1490	3.1555	3.1866	3.1925	3.2204	3.2204	3.2257	3.2096	3.1925	3.1806	3.1682	
util living area	0.9920	0.9866	0.9732	0.9378	0.8640	0.7375	0.5997	0.6575	0.8556	0.9621	0.9877	0.9934	(86)
MIT	18.8013	19.0123	19.4043	19.9409	20.4243	20.7723	20.9162	20.8854	20.5928	19.9581	19.2917	18.7734	(87)
Th 2	19.9494	19.9523	19.9551	19.9683	19.9708	19.9824	19.9824	19.9846	19.9780	19.9708	19.9658	19.9605	(88)
util rest of house	0.9904	0.9839	0.9674	0.9233	0.8293	0.6656	0.4877	0.5493	0.8049	0.9506	0.9847	0.9920	(89)
MIT 2	17.9297	18.1416	18.5325	19.0683	19.5289	19.8427	19.9471	19.9320	19.6979	19.0942	18.4307	17.9098	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0493	18.2611	18.6522	19.1881	19.6518	19.9703	20.0801	20.0629	19.8207	19.2127	18.5489	18.0283	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0493	18.2611	18.6522	19.1881	19.6518	19.9703	20.0801	20.0629	19.8207	19.2127	18.5489	18.0283	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9777	0.9577	0.9094	0.8165	0.6646	0.4995	0.5586	0.7955	0.9393	0.9789	0.9885	(94)
Useful gains	485.4403	558.0760	635.5838	699.3080	685.9638	552.6799	395.2349	403.7675	508.7925	508.5729	468.5030	459.3457	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1734.3044	1680.1755	1523.5459	1271.5289	980.1386	653.6208	423.5619	444.7569	699.6796	1061.6039	1418.8999	1723.5286	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	929.1549	754.0509	660.6438	411.9990	218.8660	0.0000	0.0000	0.0000	0.0000	411.4551	684.2858	940.5521	(98)
Space heating												5011.0075	(98)
Space heating per m2											(98) / (4) =	46.2185	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1144.0714	900.6520	922.8124	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7416	0.8125	0.7764	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	848.4069	731.8142	716.5005	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	168.6108	224.2339	177.7604	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												570.6051	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.1527	56.0585	44.4401	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.6513	(107)
Space cooling per m2												1.3157	(108)
Energy for space heating												46.2185	(99)
Energy for space cooling												1.3157	(108)
Total												47.5342	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)	
Water heating gains (Table 5)													
46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)	
Total internal gains													
407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)	

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)	
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)	
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)	
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)	

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												332.3747 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												83.0937 (107)
Space cooling per m2												0.7664 (108)
Energy for space heating												47.6900 (99)
Energy for space cooling												0.7664 (108)
Total												48.4564 (109)
Target Fabric Energy Efficiency (TFEE)												55.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3572	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693	(89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480 (98)
Space heating												3123.6617 (98)
RHI space heating demand												3124 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9757	0.9655	0.9427	0.8904	0.7956	0.6503	0.5082	0.5550	0.7641	0.9149	0.9645	0.9788	(86)
MIT	19.1746	19.3681	19.7198	20.1858	20.5859	20.8522	20.9511	20.9341	20.7342	20.2177	19.6203	19.1393	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9712	0.9590	0.9315	0.8680	0.7521	0.5751	0.4052	0.4520	0.6999	0.8928	0.9567	0.9748	(89)
MIT 2	17.5375	17.8184	18.3253	18.9901	19.5310	19.8633	19.9612	19.9501	19.7344	19.0486	18.1936	17.4921	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7622	18.0311	18.5167	19.1542	19.6758	19.9990	20.0970	20.0852	19.8716	19.2091	18.3894	17.7181	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6122	17.8811	18.3667	19.0042	19.5258	19.8490	19.9470	19.9352	19.7216	19.0591	18.2394	17.5681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8414	0.7296	0.5636	0.4006	0.4458	0.6804	0.8666	0.9378	0.9610	(94)
Useful gains	712.0004	770.6538	817.7740	832.2088	761.5200	575.8632	390.5889	406.5362	571.2762	657.0913	668.6588	683.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.2525	1610.9158	1468.9001	1235.8576	955.0294	633.8441	404.1700	426.0469	681.6128	1032.3103	1365.6152	1646.6284	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating												3683.4464	(98)
Space heating per m2											(98) / (4) =	33.9739	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4070.1065	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	776.2692	623.9293	535.2904	321.1349	159.0839	0.0000	0.0000	0.0000	0.0000	308.4673	554.4846	791.4469	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8309	89.7836	89.6721	89.4164	88.9008	87.3000	87.3000	87.3000	87.3000	89.3602	89.7018	89.8563	(217)
Fuel for water heating, kWh/month	199.4557	174.9902	181.8761	160.5374	156.0581	138.8278	130.3257	147.1641	148.2179	166.7233	179.3357	193.6067	(219)
Water heating fuel used												1977.1187	(219)
Annual totals kWh/year													
Space heating fuel - main system												4070.1065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6590.8070	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4070.1065	3.4800	141.6397	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.1187	3.4800	68.8037	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			402.1419	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1009	(257)
SAP value		84.6425	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4070.1065	0.2160	879.1430	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.1187	0.2160	427.0576	(264)
Space and water heating			1306.2007	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1588.3196	(272)
CO2 emissions per m2			14.6500	(273)
EI value			86.1273	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693	(89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating												3123.6617	(98)
Space heating per m2											(98) / (4) =	28.8108	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3451.5599	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	690.3134	557.0119	455.6046	249.8163	96.9078	0.0000	0.0000	0.0000	0.0000	231.6142	469.0232	701.2686	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7666	89.7186	89.5694	89.2298	88.5122	87.3000	87.3000	87.3000	87.3000	89.1424	89.5974	89.7919	(217)
Fuel for water heating, kWh/month	199.5984	175.1171	182.0846	160.8730	156.7434	138.8278	130.3257	147.1641	148.2179	167.1306	179.5447	193.7456	(219)
Water heating fuel used												1979.3730	(219)
Annual totals kWh/year													
Space heating fuel - main system												3451.5599	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5974.5147	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3451.5599	3.9200	135.3011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.3730	3.9200	77.5914	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			393.0840	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3451.5599	0.2160	745.5369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3730	0.2160	427.5446	(264)
Space and water heating			1173.0815	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1455.2004	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3451.5599	1.2200	4210.9031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.3730	1.2200	2414.8350	(264)
Space and water heating			6625.7382	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8294.5341	(272)
Primary energy kWh/m2/year			76.5037	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-191 kg (13.2%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (74.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 94	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£301	£261	£39
Space heating	£236	£236	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£393	£53	£340
Total cost of uses	£393	£53	£340
Delivered energy	55 kWh/m²	29 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	15 kWh/m²	62 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9757	0.9655	0.9427	0.8904	0.7956	0.6503	0.5082	0.5550	0.7641	0.9149	0.9645	0.9788	(86)
MIT	19.1746	19.3681	19.7198	20.1858	20.5859	20.8522	20.9511	20.9341	20.7342	20.2177	19.6203	19.1393	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9712	0.9590	0.9315	0.8680	0.7521	0.5751	0.4052	0.4520	0.6999	0.8928	0.9567	0.9748	(89)
MIT 2	17.5375	17.8184	18.3253	18.9901	19.5310	19.8633	19.9612	19.9501	19.7344	19.0486	18.1936	17.4921	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7622	18.0311	18.5167	19.1542	19.6758	19.9990	20.0970	20.0852	19.8716	19.2091	18.3894	17.7181	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6122	17.8811	18.3667	19.0042	19.5258	19.8490	19.9470	19.9352	19.7216	19.0591	18.2394	17.5681	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8414	0.7296	0.5636	0.4006	0.4458	0.6804	0.8666	0.9378	0.9610	(94)
Useful gains	712.0004	770.6538	817.7740	832.2088	761.5200	575.8632	390.5889	406.5362	571.2762	657.0913	668.6588	683.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1656.2525	1610.9158	1468.9001	1235.8576	955.0294	633.8441	404.1700	426.0469	681.6128	1032.3103	1365.6152	1646.6284	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating												3683.4464	(98)
Space heating per m2											(98) / (4) =	33.9739	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4070.1065	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.5236	564.6561	484.4378	290.6271	143.9710	0.0000	0.0000	0.0000	0.0000	279.1629	501.8086	716.2594	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	776.2692	623.9293	535.2904	321.1349	159.0839	0.0000	0.0000	0.0000	0.0000	308.4673	554.4846	791.4469	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9081	89.9430	89.9784	90.0411	90.1080	87.3000	87.3000	87.3000	87.3000	89.6663	89.8193	89.9207	(217)
Fuel for water heating, kWh/month													
	171.0733	127.6221	101.1433	52.1301	21.5138	4.4162	0.0000	31.2800	57.4574	105.8110	145.6055	169.8636	(219)
Water heating fuel used												987.9163	(219)
Annual totals kWh/year													
Space heating fuel - main system												4070.1065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3924.3652	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4070.1065	3.4800	141.6397	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9163	3.4800	34.3795	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			146.4898	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4010 (257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.4057	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4070.1065	0.2160	879.1430	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9163	0.2160	213.3899	(264)
Space and water heating			1092.5329	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			504.1646	(272)
CO2 emissions per m2			4.6500	(273)
EI value			95.5965	
EI rating			96	(274)
EI band			A	

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9708	0.9602	0.9313	0.8620	0.7329	0.5223	0.3596	0.3897	0.6745	0.8857	0.9544	0.9743	(86)
MIT	19.3648	19.5330	19.8994	20.3561	20.7333	20.9411	20.9878	20.9842	20.8530	20.3972	19.8194	19.3383	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9652	0.9525	0.9175	0.8334	0.6765	0.4315	0.2472	0.2733	0.5915	0.8553	0.9440	0.9693 (89)
MIT 2	17.8255	18.0700	18.5943	19.2339	19.7255	19.9588	19.9925	19.9941	19.8784	19.3063	18.4921	17.7923 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0368	18.2708	18.7734	19.3879	19.8638	20.0936	20.1291	20.1300	20.0121	19.4560	18.6742	18.0045 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8868	18.1208	18.6234	19.2379	19.7138	19.9436	19.9791	19.9800	19.8621	19.3060	18.5242	17.8545 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8931	0.8076	0.6591	0.4263	0.2452	0.2710	0.5789	0.8289	0.9230	0.9539	(94)
Useful gains	717.3121	767.9738	806.6220	811.3685	691.2507	453.1317	247.2769	257.6964	503.3054	643.4555	674.0147	687.1352	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1557.0078	1518.1163	1360.8184	1125.3737	809.1291	471.7763	249.1695	260.3449	557.7315	925.1905	1263.5508	1540.1568	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating												3123.6617	(98)
Space heating per m2											(98) / (4) =	28.8108	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3451.5599	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.7336	504.0957	412.3221	226.0838	87.7016	0.0000	0.0000	0.0000	0.0000	209.6108	424.4660	634.6480	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	690.3134	557.0119	455.6046	249.8163	96.9078	0.0000	0.0000	0.0000	0.0000	231.6142	469.0232	701.2686	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8564	89.8844	89.8906	89.9282	89.8160	87.3000	87.3000	87.3000	87.3000	89.4947	89.7402	89.8662	(217)
Fuel for water heating, kWh/month													
	168.8328	128.8675	104.0933	52.7598	25.6071	0.0000	0.0000	25.5558	53.3022	103.4867	142.0569	168.2640	(219)
Water heating fuel used												972.8262	(219)
Annual totals kWh/year													
Space heating fuel - main system												3451.5599	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3193.8082	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3451.5599	3.9200	135.3011	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	972.8262	3.9200	38.1348	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			52.7299	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3451.5599	0.2160	745.5369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8262	0.2160	210.1304	(264)
Space and water heating			955.6674	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			316.9975	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3451.5599	1.2200	4210.9031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8262	1.2200	1186.8479	(264)
Space and water heating			5397.7510	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1619.8769	(272)
Primary energy kWh/m2/year			14.9408	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-312	**Issued on Date**	19/10/2022
Assessment Reference	Plot 312	**Prop Type Ref**	3T-Opp-SEMI
Property	Plot 312, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	15.81	**TER**	17.43
Environmental	86 B	**% DER<TER**	9.30		
CO_2 Emissions (t/year)	1.43	**DFEE**	46.15	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.53		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.81 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9891	0.9812	0.9638	0.9229	0.8434	0.7121	0.5698	0.6182	0.8195	0.9471	0.9826	0.9910	(86)
MIT	18.9389	19.1656	19.5502	20.0506	20.4926	20.8045	20.9315	20.9091	20.6636	20.0756	19.4177	18.9015	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9870	0.9775	0.9563	0.9056	0.8056	0.6385	0.4603	0.5111	0.7623	0.9319	0.9785	0.9892	(89)
MIT 2	17.1965	17.5275	18.0856	18.8070	19.4167	19.8171	19.9483	19.9322	19.6563	18.8551	17.9035	17.1476	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4356	17.7523	18.2866	18.9777	19.5643	19.9526	20.0833	20.0663	19.7946	19.0226	18.1113	17.3883	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2856	17.6023	18.1366	18.8277	19.4143	19.8026	19.9333	19.9163	19.6446	18.8726	17.9613	17.2383	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9780	0.9645	0.9371	0.8801	0.7802	0.6230	0.4536	0.5022	0.7388	0.9087	0.9660	0.9815	(94)
Useful gains	546.0195	630.4086	703.4650	744.9123	704.6559	550.7980	383.0349	396.2525	531.5838	565.3140	529.3678	516.1977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1615.6272	1576.3129	1440.4178	1214.2683	941.4290	628.2347	402.5055	423.7740	672.2670	1009.5518	1331.5194	1605.9986	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	795.7881	635.6477	548.2929	337.9363	176.1592	0.0000	0.0000	0.0000	0.0000	330.5129	577.5492	810.8119	(98)
Space heating												4212.6980	(98)
Space heating per m2											(98) / (4) =	38.8554	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4654.9149	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	795.7881	635.6477	548.2929	337.9363	176.1592	0.0000	0.0000	0.0000	0.0000	330.5129	577.5492	810.8119	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	879.3239	702.3731	605.8485	373.4103	194.6510	0.0000	0.0000	0.0000	0.0000	365.2076	638.1759	895.9247	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8944	89.8473	89.7458	89.5217	89.0617	87.3000	87.3000	87.3000	87.3000	89.4809	89.7830	89.9177	(217)
Fuel for water heating, kWh/month	199.3146	174.8662	181.7267	160.3485	155.7762	138.8278	130.3257	147.1641	148.2179	166.4984	179.1735	193.4745	(219)
Water heating fuel used												1975.7142	(219)
Annual totals kWh/year													
Space heating fuel - main system												4654.9149	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7174.2109	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4654.9149	0.2160	1005.4616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7142	0.2160	426.7543	(264)
Space and water heating			1432.2159	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1714.3348	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.8100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.8100	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.2455	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2455	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4895.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month													
	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	126.1377	125.7512	125.3723	123.5927	123.2597	121.7097	121.7097	121.4227	122.3068	123.2597	123.9333	124.6375	(39)
Average = Sum(39)m / 12 =												123.5911	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1634	1.1599	1.1564	1.1399	1.1369	1.1226	1.1226	1.1199	1.1281	1.1369	1.1431	1.1496	(40)
HLP (average)												1.1399	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1369	32.2357	32.3331	32.7987	32.8873	33.3061	33.3061	33.3848	33.1435	32.8873	32.7085	32.5237	
alpha	3.1425	3.1490	3.1555	3.1866	3.1925	3.2204	3.2204	3.2257	3.2096	3.1925	3.1806	3.1682	
util living area	0.9905	0.9832	0.9669	0.9282	0.8525	0.7248	0.5840	0.6343	0.8317	0.9523	0.9848	0.9922	(86)
MIT	18.8428	19.0754	19.4713	19.9916	20.4521	20.7844	20.9225	20.8971	20.6321	20.0175	19.3397	18.8100	(87)
Th 2	19.9494	19.9523	19.9551	19.9683	19.9708	19.9824	19.9824	19.9846	19.9780	19.9708	19.9658	19.9605	(88)
util rest of house	0.9886	0.9798	0.9600	0.9119	0.8160	0.6519	0.4731	0.5264	0.7765	0.9384	0.9812	0.9906	(89)
MIT 2	17.9709	18.2040	18.5979	19.1161	19.5529	19.8511	19.9501	19.9382	19.7292	19.1507	18.4781	17.9462	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0906	18.3236	18.7177	19.2363	19.6763	19.9792	20.0835	20.0698	19.8532	19.2697	18.5963	18.0647	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0906	18.3236	18.7177	19.2363	19.6763	19.9792	20.0835	20.0698	19.8532	19.2697	18.5963	18.0647	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8975	0.8037	0.6517	0.4850	0.5364	0.7685	0.9260	0.9745	0.9865	(94)
Useful gains	515.3278	603.0012	682.1779	733.1898	703.4324	559.3723	397.9330	409.1063	532.1607	548.6584	502.4535	485.6678	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1739.5086	1688.0364	1531.7653	1277.4892	983.1534	654.7047	423.9805	445.5932	703.6505	1068.6258	1424.7765	1728.0660	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	910.7906	729.1436	632.0930	391.8955	208.1125	0.0000	0.0000	0.0000	0.0000	386.8558	664.0725	924.3443	(98)
Space heating												4847.3078	(98)
Space heating per m2											(98) / (4) =	44.7086	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1144.0714	900.6520	922.8124	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7527	0.8233	0.7938	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	861.1882	741.5189	732.5250	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	181.9101	242.3751	200.5673	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												624.8525	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.4775	60.5938	50.1418	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.2131	(107)
Space cooling per m2												1.4408	(108)
Energy for space heating												44.7086	(99)
Energy for space cooling												1.4408	(108)
Total												46.1494	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/	(5) =	0.1423	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3923	(18)
Number of sides sheltered				1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.1800	16.8642			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)	

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1067	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3572	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.7912 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659	(89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375 (98)
Space heating												3007.4150 (98)
RHI space heating demand												3007 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9729	0.9598	0.9338	0.8788	0.7836	0.6390	0.4959	0.5365	0.7401	0.9014	0.9595	0.9765	(86)
MIT	19.2133	19.4258	19.7786	20.2274	20.6064	20.8598	20.9545	20.9403	20.7601	20.2663	19.6636	19.1736	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house	0.9678	0.9524	0.9212	0.8547	0.7390	0.5638	0.3945	0.4353	0.6740	0.8767	0.9507	0.9721	(89)
MIT 2	17.5930	17.9006	18.4076	19.0455	19.5555	19.8705	19.9633	19.9544	19.7620	19.1136	18.2551	17.5415	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8154	18.1099	18.5958	19.2077	19.6997	20.0063	20.0994	20.0897	19.8990	19.2718	18.4484	17.7655	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6654	17.9599	18.4458	19.0577	19.5497	19.8563	19.9494	19.9397	19.7490	19.1218	18.2984	17.6155	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8968	0.8282	0.7173	0.5530	0.3903	0.4298	0.6562	0.8501	0.9306	0.9574	(94)
Useful gains	738.8137	809.9921	856.9441	858.8269	773.9095	579.8194	391.8671	409.0568	585.6329	688.0443	697.9737	707.7445	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1662.8785	1620.6964	1478.6897	1242.4007	957.9491	634.7165	404.4500	426.5991	684.9290	1039.9641	1372.8515	1652.4579	(97)

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Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating												3558.5821	(98)
Space heating per m2											(98) / (4) =	32.8222	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3932.1349	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.6732	601.9816	511.1368	305.1637	151.2989	0.0000	0.0000	0.0000	0.0000	289.3131	536.9194	776.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8194	89.7635	89.6435	89.3795	88.8607	87.3000	87.3000	87.3000	87.3000	89.3127	89.6824	89.8466	(217)
Fuel for water heating, kWh/month	199.4813	175.0294	181.9342	160.6036	156.1286	138.8278	130.3257	147.1641	148.2179	166.8119	179.3746	193.6277	(219)
Water heating fuel used												1977.5268	(219)
Annual totals kWh/year													
Space heating fuel - main system												3932.1349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6453.2434	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3932.1349	3.4800	136.8383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.5268	3.4800	68.8179	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			397.3547	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0878	(257)
SAP value		84.8253	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3932.1349	0.2160	849.3411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.5268	0.2160	427.1458	(264)
Space and water heating			1276.4869	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1558.6058	(272)
CO2 emissions per m2			14.3800	(273)
EI value			86.3868	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659	(89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating												3007.4150	(98)
Space heating per m2											(98) / (4) =	27.7386	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3323.1104	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	672.8440	536.3996	434.1839	236.6342	91.9352	0.0000	0.0000	0.0000	0.0000	214.6706	450.6556	685.7873	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7520	89.6961	89.5373	89.1881	88.4728	87.3000	87.3000	87.3000	87.3000	89.0828	89.5713	89.7795	(217)
Fuel for water heating, kWh/month													
	199.6309	175.1610	182.1499	160.9483	156.8132	138.8278	130.3257	147.1641	148.2179	167.2425	179.5971	193.7724	(219)
Water heating fuel used												1979.8508	(219)
Annual totals kWh/year													
Space heating fuel - main system												3323.1104	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5846.5430	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3323.1104	3.9200	130.2659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.8508	3.9200	77.6102	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			388.0675	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3323.1104	0.2160	717.7919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8508	0.2160	427.6478	(264)
Space and water heating			1145.4396	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1427.5585	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3323.1104	1.2200	4054.1947	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8508	1.2200	2415.4179	(264)
Space and water heating			6469.6127	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8138.4086	(272)
Primary energy kWh/m2/year			75.0637	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-192 kg (13.4%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (76.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 95	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£296	£256	£39
Space heating	£231	£231	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£388	£48	£340
Total cost of uses	£388	£48	£340
Delivered energy	54 kWh/m²	28 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	13 kWh/m²	62 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.4165	124.0968	123.7835	122.3115	122.0362	120.7542	120.7542	120.5168	121.2480	122.0362	122.5933	123.1757	(39)
Average = Sum(39)m / 12 =												122.3102	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1475	1.1446	1.1417	1.1281	1.1256	1.1138	1.1138	1.1116	1.1183	1.1256	1.1307	1.1361	(40)
HLP (average)												1.1281	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
								Solar input (sum of months) = Sum(63)m =				-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
								Total per year (kWh/year) = Sum(64)m =				885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.0794	33.1646	33.2486	33.6487	33.7247	34.0827	34.0827	34.1498	33.9439	33.7247	33.5714	33.4127	
alpha	3.2053	3.2110	3.2166	3.2432	3.2483	3.2722	3.2722	3.2767	3.2629	3.2483	3.2381	3.2275	
util living area	0.9729	0.9598	0.9338	0.8788	0.7836	0.6390	0.4959	0.5365	0.7401	0.9014	0.9595	0.9765	(86)
MIT	19.2133	19.4258	19.7786	20.2274	20.6064	20.8598	20.9545	20.9403	20.7601	20.2663	19.6636	19.1736	(87)
Th 2	19.9622	19.9646	19.9669	19.9779	19.9800	19.9896	19.9896	19.9914	19.9859	19.9800	19.9758	19.9715	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9678	0.9524	0.9212	0.8547	0.7390	0.5638	0.3945	0.4353	0.6740	0.8767	0.9507	0.9721	(89)
MIT 2	17.5930	17.9006	18.4076	19.0455	19.5555	19.8705	19.9633	19.9544	19.7620	19.1136	18.2551	17.5415	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8154	18.1099	18.5958	19.2077	19.6997	20.0063	20.0994	20.0897	19.8990	19.2718	18.4484	17.7655	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6654	17.9599	18.4458	19.0577	19.5497	19.8563	19.9494	19.9397	19.7490	19.1218	18.2984	17.6155	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8968	0.8282	0.7173	0.5530	0.3903	0.4298	0.6562	0.8501	0.9306	0.9574	(94)
Useful gains	738.8137	809.9921	856.9441	858.8269	773.9095	579.8194	391.8671	409.0568	585.6329	688.0443	697.9737	707.7445	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1662.8785	1620.6964	1478.6897	1242.4007	957.9491	634.7165	404.4500	426.5991	684.9290	1039.9641	1372.8515	1652.4579	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating												3558.5821	(98)
Space heating per m2											(98) / (4) =	32.8222	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3932.1349	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.5042	544.7933	462.5788	276.1731	136.9255	0.0000	0.0000	0.0000	0.0000	261.8283	485.9120	702.8668	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	759.6732	601.9816	511.1368	305.1637	151.2989	0.0000	0.0000	0.0000	0.0000	289.3131	536.9194	776.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8976	89.9263	89.9579	90.0206	90.0905	87.3000	87.3000	87.3000	87.3000	89.6262	89.8019	89.9116	(217)
Fuel for water heating, kWh/month	171.0932	127.6457	101.1663	52.1419	21.5180	4.4162	0.0000	31.2800	57.4574	105.8584	145.6337	169.8806	(219)
Water heating fuel used												988.0916	(219)
Annual totals kWh/year													
Space heating fuel - main system												3932.1349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3786.5688	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3932.1349	3.4800	136.8383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.0916	3.4800	34.3856	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			141.6944	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.3879	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	94.5888	
SAP rating (Section 12)	95	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3932.1349	0.2160	849.3411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.0916	0.2160	213.4278	(264)
Space and water heating			1062.7689	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			474.4006	(272)
CO2 emissions per m2			4.3800	(273)
EI value			95.8565	
EI rating			96	(274)
EI band			A	

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	109.7100	16.0200	93.6900	0.2500	23.4225	52.1000	4881.2490	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.8258			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.7912	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.7671	121.2480	121.2480	120.5168	120.5168	119.6305	119.8425	119.4247	119.6305	120.0609	120.0609	120.7542	(39)
Average = Sum(39)m / 12 =												120.3917	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1183	1.1183	1.1116	1.1116	1.1034	1.1054	1.1015	1.1034	1.1074	1.1074	1.1138	(40)
HLP (average)												1.1104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7992	33.9439	33.9439	34.1498	34.1498	34.4028	34.3420	34.4621	34.4028	34.2795	34.2795	34.0827	
alpha	3.2533	3.2629	3.2629	3.2767	3.2767	3.2935	3.2895	3.2975	3.2935	3.2853	3.2853	3.2722	
util living area	0.9672	0.9540	0.9216	0.8493	0.7210	0.5125	0.3507	0.3755	0.6488	0.8688	0.9476	0.9714	(86)
MIT	19.4059	19.5876	19.9521	20.3908	20.7469	20.9444	20.9887	20.9858	20.8695	20.4413	19.8655	19.3745	(87)
Th 2	19.9820	19.9859	19.9859	19.9914	19.9914	19.9981	19.9965	19.9996	19.9981	19.9948	19.9948	19.9896	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9609	0.9453	0.9063	0.8192	0.6639	0.4227	0.2409	0.2628	0.5656	0.8355	0.9359	0.9659 (89)
MIT 2	17.8844	18.1475	18.6673	19.2789	19.7404	19.9611	19.9928	19.9947	19.8933	19.3629	18.5568	17.8444 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.0932	18.3451	18.8437	19.4315	19.8786	20.0961	20.1295	20.1307	20.0273	19.5109	18.7364	18.0544 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9432	18.1951	18.6937	19.2815	19.7286	19.9461	19.9795	19.9807	19.8773	19.3609	18.5864	17.9044 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8811	0.7938	0.6473	0.4178	0.2390	0.2607	0.5545	0.8095	0.9137	0.9495	(94)
Useful gains	745.4371	804.7509	841.1927	833.1872	699.0746	454.4906	247.4645	258.0799	511.5009	670.6531	704.5629	711.9902	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1563.8831	1527.1344	1369.3330	1130.6232	810.9043	472.0685	249.2145	260.4352	559.5458	931.7779	1271.0120	1546.1804	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating												3007.4150	(98)
Space heating per m2											(98) / (4) =	27.7386	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3323.1104	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	608.9238	485.4417	392.9364	214.1540	83.2013	0.0000	0.0000	0.0000	0.0000	194.2769	407.8434	620.6375	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	672.8440	536.3996	434.1839	236.6342	91.9352	0.0000	0.0000	0.0000	0.0000	214.6706	450.6556	685.7873	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8432	89.8654	89.8664	89.9023	89.7872	87.3000	87.3000	87.3000	87.3000	89.4416	89.7169	89.8547	(217)
Fuel for water heating, kWh/month	168.8578	128.8947	104.1213	52.7750	25.6153	0.0000	0.0000	25.5558	53.3022	103.5482	142.0939	168.2854	(219)
Water heating fuel used												973.0495	(219)
Annual totals kWh/year													
Space heating fuel - main system												3323.1104	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3065.5820	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3323.1104	3.9200	130.2659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.0495	3.9200	38.1435	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			47.7035	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3323.1104	0.2160	717.7919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0495	0.2160	210.1787	(264)
Space and water heating			927.9705	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			289.3006	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3323.1104	1.2200	4054.1947	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0495	1.2200	1187.1204	(264)
Space and water heating			5241.3151	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1463.4410	(272)
Primary energy kWh/m2/year			13.4979	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.79	(37)
Summer heat loss coefficient	440.93	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						639.6507

	Jun	Jul	Aug	
Solar gains	676	640	575	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1183	1125	1070	(P5)
Summer gain/loss ratio	2.68	2.55	2.43	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.73	21.49	21.27	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-313	**Issued on Date**	19/10/2022
Assessment Reference	Plot 313	**Prop Type Ref**	3T-As-SEMI
Property	Plot 313, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	16.11	**TER**	17.77
Environmental	86 B	**% DER<TER**	9.35		
CO_2 Emissions (t/year)	1.45	**DFEE**	47.45	**TFEE**	55.72
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.85		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.77 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.11 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 4.12 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.2373	123.9176	123.6043	122.1323	121.8570	120.5750	120.5750	120.3376	121.0688	121.8570	122.4141	122.9965	(39)
Average = Sum(39)m / 12 =												122.1310	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1429	1.1401	1.1265	1.1239	1.1121	1.1121	1.1099	1.1167	1.1239	1.1291	1.1344	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
									Total per year (kWh/year) = Sum(64)m =			1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	526.6813	604.4248	695.5491	798.4863	868.0023	857.3457	815.2190	749.0553	666.7325	571.0298	510.9894	498.3315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1271	33.2126	33.2968	33.6981	33.7743	34.1333	34.1333	34.2007	33.9941	33.7743	33.6205	33.4613	
alpha	3.2085	3.2142	3.2198	3.2465	3.2516	3.2756	3.2756	3.2800	3.2663	3.2516	3.2414	3.2308	
util living area	0.9908	0.9849	0.9704	0.9328	0.8550	0.7243	0.5846	0.6405	0.8436	0.9574	0.9857	0.9923	(86)
MIT	18.9009	19.1063	19.4872	20.0037	20.4680	20.7943	20.9264	20.8992	20.6280	20.0199	19.3731	18.8684	(87)
Th 2	19.9635	19.9659	19.9683	19.9793	19.9813	19.9910	19.9910	19.9927	19.9872	19.9813	19.9772	19.9728	(88)
util rest of house	0.9889	0.9818	0.9640	0.9172	0.8188	0.6515	0.4740	0.5327	0.7905	0.9447	0.9823	0.9908	(89)
MIT 2	17.1421	17.4426	17.9967	18.7435	19.3869	19.8081	19.9461	19.9261	19.6165	18.7786	17.8399	17.1002	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.3835	17.6709	18.2013	18.9165	19.5353	19.9434	20.0806	20.0597	19.7553	18.9490	18.0503	17.3429	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2335	17.5209	18.0513	18.7665	19.3853	19.7934	19.9306	19.9097	19.6053	18.7990	17.9003	17.1929	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9706	0.9468	0.8926	0.7930	0.6352	0.4668	0.5228	0.7655	0.9234	0.9713	0.9839	(94)
Useful gains	516.7088	586.6387	658.5609	712.7332	688.2999	544.5660	380.5309	391.5718	510.3717	527.2947	496.3412	490.3268	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1606.8217	1563.9547	1427.7878	1205.0169	936.5020	626.1991	401.5925	422.3459	666.5208	999.1023	1322.1110	1598.0770 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	811.0440	656.7563	572.3049	354.4443	184.6623	0.0000	0.0000	0.0000	0.0000	351.0248	594.5542	824.1662 (98)
Space heating												4348.9569 (98)
Space heating per m2											(98) / (4) =	40.1121 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4805.4772 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	811.0440	656.7563	572.3049	354.4443	184.6623	0.0000	0.0000	0.0000	0.0000	351.0248	594.5542	824.1662	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	896.1812	725.6976	632.3811	391.6511	204.0467	0.0000	0.0000	0.0000	0.0000	387.8727	656.9660	910.6808	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9037	89.8641	89.7702	89.5538	89.0989	87.3000	87.3000	87.3000	87.3000	89.5222	89.7991	89.9255	(217)
Fuel for water heating, kWh/month													
	199.2941	174.8335	181.6773	160.2910	155.7111	138.8278	130.3257	147.1641	148.2179	166.4215	179.1415	193.4578	(219)
Water heating fuel used												1975.3634	(219)
Annual totals kWh/year													
Space heating fuel - main system												4805.4772	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7324.4224	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4805.4772	0.2160	1037.9831	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.3634	0.2160	426.6785	(264)
Space and water heating			1464.6616	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1746.7805	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.1100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.1100	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.5455	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.5455	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4859	(36)
Total fabric heat loss (33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	527.2890	594.0295	670.4304	755.4597	811.0782	797.7122	759.1439	703.6526	635.1930	556.4371	508.7700	500.9859	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9993	0.9985	0.9956	0.9835	0.9388	0.8162	0.6515	0.7141	0.9251	0.9915	0.9985	0.9994	(86)
MIT	19.6807	19.8068	20.0456	20.3823	20.6940	20.9089	20.9785	20.9659	20.7982	20.3959	19.9852	19.6658	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9990	0.9979	0.9939	0.9763	0.9102	0.7343	0.5210	0.5867	0.8776	0.9868	0.9979	0.9993	(89)
MIT 2	18.2043	18.3907	18.7414	19.2386	19.6742	19.9430	20.0017	19.9967	19.8228	19.2638	18.6616	18.1904	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4069	18.5851	18.9204	19.3955	19.8141	20.0756	20.1357	20.1298	19.9567	19.4192	18.8432	18.3929	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9967	0.9913	0.9704	0.9035	0.7404	0.5386	0.6032	0.8745	0.9826	0.9967	0.9988	(94)
Useful gains	526.4254	592.0872	664.5997	733.0880	732.8387	590.6614	408.8712	424.4471	555.5067	546.7741	507.1127	500.3612	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1726.6588	1669.7483	1510.7463	1257.9881	969.8595	646.0153	417.1518	438.9729	694.4680	1054.1291	1411.5270	1715.9444	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating												4734.0108	(98)
Space heating per m2											(98) / (4) =	43.6636	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5068.5340	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	892.9737	724.1882	629.5331	377.9281	176.3435	0.0000	0.0000	0.0000	0.0000	377.4721	651.1783	904.3939	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	956.0746	775.3621	674.0183	404.6339	188.8046	0.0000	0.0000	0.0000	0.0000	404.1457	697.1930	968.3018	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2429	88.0983	87.7453	86.8987	85.1073	80.3000	80.3000	80.3000	80.3000	86.8048	87.8439	88.3051	(217)
Fuel for water heating, kWh/month													
	244.1233	215.5176	227.2360	204.9851	202.6391	189.1577	181.2275	202.0262	204.2574	213.4943	223.1050	238.0746	(219)
Water heating fuel used												2545.8438	(219)
Annual totals kWh/year													
Space heating fuel - main system												5068.5340	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												8157.9596	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5068.5340	0.2160	1094.8034	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.8438	0.2160	549.9023	(264)
Space and water heating			1644.7056	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1926.8245	(272)
Emissions per m2 for space and water heating			15.1698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1698 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.7700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	125.9585	125.5720	125.1931	123.4135	123.0805	121.5305	121.5305	121.2435	122.1276	123.0805	123.7541	124.4583	(39)
Average = Sum(39)m / 12 =												123.4119	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1618	1.1582	1.1547	1.1383	1.1352	1.1209	1.1209	1.1183	1.1264	1.1352	1.1414	1.1479	(40)
HLP (average)												1.1383	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	492.2121	570.8013	663.6820	769.0084	840.0795	831.6094	791.3369	722.7929	639.6209	541.4455	478.6146	464.7045	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1826	32.2817	32.3794	32.8463	32.9352	33.3552	33.3552	33.4342	33.1922	32.9352	32.7559	32.5706	
alpha	3.1455	3.1521	3.1586	3.1898	3.1957	3.2237	3.2237	3.2289	3.2128	3.1957	3.1837	3.1714	
util living area													
	0.9920	0.9866	0.9732	0.9377	0.8638	0.7371	0.5992	0.6571	0.8554	0.9621	0.9877	0.9934	(86)
MIT	18.8043	19.0153	19.4071	19.9432	20.4261	20.7733	20.9167	20.8860	20.5941	19.9602	19.2943	18.7764	(87)
Th 2	19.9507	19.9536	19.9564	19.9697	19.9722	19.9838	19.9838	19.9859	19.9793	19.9722	19.9671	19.9619	(88)
util rest of house													
	0.9904	0.9839	0.9674	0.9232	0.8291	0.6652	0.4874	0.5490	0.8047	0.9506	0.9847	0.9921	(89)
MIT 2	17.9336	18.1455	18.5362	19.0716	19.5316	19.8447	19.9486	19.9336	19.7001	19.0971	18.4343	17.9138	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.0531	18.2649	18.6557	19.1912	19.6544	19.9721	20.0815	20.0643	19.8228	19.2156	18.5523	18.0322	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0531	18.2649	18.6557	19.1912	19.6544	19.9721	20.0815	20.0643	19.8228	19.2156	18.5523	18.0322	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9777	0.9577	0.9093	0.8164	0.6643	0.4991	0.5583	0.7953	0.9393	0.9789	0.9885	(94)
Useful gains	485.4450	558.0796	635.5777	699.2566	685.8070	552.3996	394.9457	403.5071	508.6643	508.5585	468.5065	459.3502	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1732.3239	1678.2573	1521.8157	1270.0784	979.0279	652.8796	423.1074	444.2785	698.9104	1060.4101	1417.2698	1721.5316	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	927.6778	752.7594	659.3611	410.9917	218.1564	0.0000	0.0000	0.0000	0.0000	410.5776	683.1096	939.0630	(98)
Space heating												5001.6966	(98)
Space heating per m2											(98) / (4) =	46.1326	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1142.3869	899.3259	921.4505	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7423	0.8132	0.7772	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	848.0276	731.3561	716.1208	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1082.5886	1033.2039	955.4258	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	168.8839	224.5748	178.0430	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												571.5016	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.2210	56.1437	44.5107	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.8754	(107)
Space cooling per m2												1.3178	(108)
Energy for space heating												46.1326	(99)
Energy for space cooling												1.3178	(108)
Total												47.4504	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	72.7918	142.0337	234.7129	346.1676	429.3307	442.1388	419.8224	356.9226	274.0047	168.5930	90.6564	59.9511	(83)
Total gains	480.6395	548.2205	626.3668	713.9740	771.8236	761.3173	724.5927	666.0486	596.0591	514.6422	464.2018	455.1733	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9995	0.9989	0.9968	0.9870	0.9488	0.8366	0.6762	0.7426	0.9399	0.9940	0.9990	0.9997	(86)
MIT	19.6403	19.7672	20.0080	20.3489	20.6686	20.8965	20.9745	20.9590	20.7743	20.3608	19.9465	19.6260	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9994	0.9986	0.9955	0.9812	0.9237	0.7581	0.5438	0.6153	0.8990	0.9906	0.9986	0.9995	(89)
MIT 2	18.7264	18.8555	19.0980	19.4467	19.7550	19.9569	20.0032	19.9992	19.8620	19.4627	19.0457	18.7211	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8518	18.9806	19.2229	19.5705	19.8804	20.0858	20.1365	20.1309	19.9872	19.5859	19.1693	18.8452	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9942	0.9779	0.9199	0.7650	0.5619	0.6322	0.8980	0.9885	0.9981	0.9993	(94)
Useful gains	480.1993	547.1351	622.7410	698.2197	710.0374	582.4228	407.1839	421.0942	535.2352	508.7342	463.3346	454.8643	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1781.1120	1718.0108	1547.5437	1278.9563	977.7823	647.2266	417.2386	439.1059	698.0895	1074.0616	1450.7228	1770.6324	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	967.8790	786.8285	688.0532	418.1303	199.2023	0.0000	0.0000	0.0000	0.0000	420.6036	710.9195	978.9314	(98)
Space heating												5170.5478	(98)
Space heating per m2											(98) / (4) =	47.6900	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7939	0.8754	0.8378	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	880.4462	764.2396	749.4250	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.4289	955.1911	889.1013	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	86.3876	142.0679	103.9192	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												332.3747	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	21.5969	35.5170	25.9798	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												83.0937	(107)
Space cooling per m2												0.7664	(108)
Energy for space heating												47.6900	(99)
Energy for space cooling												0.7664	(108)
Total												48.4564	(109)
Target Fabric Energy Efficiency (TFEE)												55.7	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067 (8)
Pressure test				Yes
Measured/design AP50				5.0100
Infiltration rate				0.3572 (18)
Number of sides sheltered				1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =		0.3304 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.6120 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.5879	121.0688	121.0688	120.3376	120.3376	119.4513	119.6633	119.2455	119.4513	119.8817	119.8817	120.5750	(39)
Average = Sum(39)m / 12 =												120.2125	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1167	1.1167	1.1099	1.1099	1.1017	1.1037	1.0998	1.1017	1.1057	1.1057	1.1121	(40)
HLP (average)												1.1088	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8490	33.9941	33.9941	34.2007	34.2007	34.4545	34.3934	34.5139	34.4545	34.3307	34.3307	34.1333	
alpha	3.2566	3.2663	3.2663	3.2800	3.2800	3.2970	3.2929	3.3009	3.2970	3.2887	3.2887	3.2756	
util living area	0.9708	0.9601	0.9312	0.8618	0.7325	0.5217	0.3591	0.3892	0.6740	0.8855	0.9543	0.9743	(86)
MIT	19.3679	19.5360	19.9021	20.3582	20.7345	20.9415	20.9879	20.9843	20.8537	20.3991	19.8220	19.3413	(87)
Th 2	19.9834	19.9872	19.9872	19.9927	19.9927	19.9994	19.9978	20.0010	19.9994	19.9962	19.9962	19.9910	(88)
util rest of house	0.9652	0.9525	0.9174	0.8332	0.6761	0.4311	0.2470	0.2731	0.5911	0.8551	0.9439	0.9693	(89)
MIT 2	17.8308	18.0752	18.5990	19.2377	19.7281	19.9604	19.9939	19.9955	19.8803	19.3097	18.4966	17.7976	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0417	18.2756	18.7778	19.3915	19.8662	20.0951	20.1303	20.1312	20.0139	19.4592	18.6785	18.0095	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8917	18.1256	18.6278	19.2415	19.7162	19.9451	19.9803	19.9812	19.8639	19.3092	18.5285	17.8595	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8930	0.8075	0.6587	0.4259	0.2450	0.2707	0.5785	0.8288	0.9229	0.9539	(94)
Useful gains	717.3038	767.9506	806.5527	811.1765	690.8889	452.7272	247.0643	257.4726	502.9792	643.3340	673.9860	687.1305	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	1555.3216	1516.4646	1359.3407	1124.1297	808.2119	471.2417	248.9410	260.0995	557.1112	924.1915	1262.1759	1538.4721	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	623.4853	503.0014	411.2743	225.3263	87.2883	0.0000	0.0000	0.0000	0.0000	208.9579	423.4968	633.3982	(98)
Space heating												3116.2284	(98)
RHI space heating demand												3116	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.2373	123.9176	123.6043	122.1323	121.8570	120.5750	120.5750	120.3376	121.0688	121.8570	122.4141	122.9965	(39)
Average = Sum(39)m / 12 =												122.1310	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1429	1.1401	1.1265	1.1239	1.1121	1.1121	1.1099	1.1167	1.1239	1.1291	1.1344	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1271	33.2126	33.2968	33.6981	33.7743	34.1333	34.1333	34.2007	33.9941	33.7743	33.6205	33.4613	
alpha	3.2085	3.2142	3.2198	3.2465	3.2516	3.2756	3.2756	3.2800	3.2663	3.2516	3.2414	3.2308	
util living area	0.9757	0.9654	0.9426	0.8903	0.7952	0.6498	0.5077	0.5544	0.7637	0.9148	0.9645	0.9788	(86)
MIT	19.1778	19.3712	19.7226	20.1882	20.5875	20.8529	20.9514	20.9345	20.7353	20.2197	19.6230	19.1425	(87)
Th 2	19.9635	19.9659	19.9683	19.9793	19.9813	19.9910	19.9910	19.9927	19.9872	19.9813	19.9772	19.9728	(88)
util rest of house	0.9712	0.9589	0.9314	0.8678	0.7517	0.5746	0.4049	0.4517	0.6995	0.8926	0.9566	0.9748	(89)
MIT 2	17.5429	17.8237	18.3302	18.9942	19.5341	19.8654	19.9627	19.9517	19.7368	19.0523	18.1983	17.4975	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.7673	18.0361	18.5213	19.1581	19.6787	20.0009	20.0984	20.0866	19.8739	19.2125	18.3938	17.7233	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6173	17.8861	18.3713	19.0081	19.5287	19.8509	19.9484	19.9366	19.7239	19.0625	18.2438	17.5733	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8413	0.7293	0.5632	0.4003	0.4455	0.6801	0.8665	0.9377	0.9610	(94)
Useful gains	711.9985	770.6396	817.7258	832.0691	761.2339	575.4675	390.2485	406.2030	571.0179	657.0132	668.6446	683.9147	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	1654.5004	1609.2088	1467.3432	1234.5230	953.9764	633.1264	403.7349	425.5863	680.8745	1031.2199	1364.1623	1644.8643	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	701.2214	563.5185	483.3154	289.7669	143.4004	0.0000	0.0000	0.0000	0.0000	278.4098	500.7727	714.9465	(98)
Space heating												3675.3515	(98)
Space heating per m2											(98) / (4) =	33.8992	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4061.1619	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	701.2214	563.5185	483.3154	289.7669	143.4004	0.0000	0.0000	0.0000	0.0000	278.4098	500.7727	714.9465	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	774.8302	622.6723	534.0501	320.1844	158.4535	0.0000	0.0000	0.0000	0.0000	307.6351	553.3400	789.9961	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8299	89.7825	89.6707	89.4142	88.8976	87.3000	87.3000	87.3000	87.3000	89.3582	89.7006	89.8554	(217)
Fuel for water heating, kWh/month													
	199.4579	174.9924	181.8790	160.5412	156.0637	138.8278	130.3257	147.1641	148.2179	166.7270	179.3382	193.6087	(219)
Water heating fuel used												1977.1436	(219)
Annual totals kWh/year													
Space heating fuel - main system												4061.1619	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6581.8873	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4061.1619	3.4800	141.3284	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.1436	3.4800	68.8046	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			401.8315	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1000	(257)
SAP value		84.6543	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4061.1619	0.2160	877.2110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.1436	0.2160	427.0630	(264)
Space and water heating			1304.2740	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1586.3929	(272)
CO2 emissions per m2			14.6300	(273)
EI value			86.1441	
EI rating			86	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.5879	121.0688	121.0688	120.3376	120.3376	119.4513	119.6633	119.2455	119.4513	119.8817	119.8817	120.5750	(39)
Average = Sum(39)m / 12 =												120.2125	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1167	1.1167	1.1099	1.1099	1.1017	1.1037	1.0998	1.1017	1.1057	1.1057	1.1121	(40)
HLP (average)												1.1088	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
									Total per year (kWh/year) = Sum(64)m =			1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8490	33.9941	33.9941	34.2007	34.2007	34.4545	34.3934	34.5139	34.4545	34.3307	34.3307	34.1333	
alpha	3.2566	3.2663	3.2663	3.2800	3.2800	3.2970	3.2929	3.3009	3.2970	3.2887	3.2887	3.2756	
util living area	0.9708	0.9601	0.9312	0.8618	0.7325	0.5217	0.3591	0.3892	0.6740	0.8855	0.9543	0.9743	(86)
MIT	19.3679	19.5360	19.9021	20.3582	20.7345	20.9415	20.9879	20.9843	20.8537	20.3991	19.8220	19.3413	(87)
Th 2	19.9834	19.9872	19.9872	19.9927	19.9927	19.9994	19.9978	20.0010	19.9994	19.9962	19.9962	19.9910	(88)
util rest of house	0.9652	0.9525	0.9174	0.8332	0.6761	0.4311	0.2470	0.2731	0.5911	0.8551	0.9439	0.9693	(89)
MIT 2	17.8308	18.0752	18.5990	19.2377	19.7281	19.9604	19.9939	19.9955	19.8803	19.3097	18.4966	17.7976	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0417	18.2756	18.7778	19.3915	19.8662	20.0951	20.1303	20.1312	20.0139	19.4592	18.6785	18.0095	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8917	18.1256	18.6278	19.2415	19.7162	19.9451	19.9803	19.9812	19.8639	19.3092	18.5285	17.8595	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8930	0.8075	0.6587	0.4259	0.2450	0.2707	0.5785	0.8288	0.9229	0.9539	(94)
Useful gains	717.3038	767.9506	806.5527	811.1765	690.8889	452.7272	247.0643	257.4726	502.9792	643.3340	673.9860	687.1305	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	1555.3216	1516.4646	1359.3407	1124.1297	808.2119	471.2417	248.9410	260.0995	557.1112	924.1915	1262.1759	1538.4721	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	623.4853	503.0014	411.2743	225.3263	87.2883	0.0000	0.0000	0.0000	0.0000	208.9579	423.4968	633.3982	(98)
Space heating												3116.2284	(98)
Space heating per m2											(98) / (4) =	28.7422	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3443.3463	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	623.4853	503.0014	411.2743	225.3263	87.2883	0.0000	0.0000	0.0000	0.0000	208.9579	423.4968	633.3982	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	688.9340	555.8027	454.4467	248.9793	96.4512	0.0000	0.0000	0.0000	0.0000	230.8928	467.9522	699.8875	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7655	89.7173	89.5678	89.2272	88.5086	87.3000	87.3000	87.3000	87.3000	89.1400	89.5959	89.7908	(217)
Fuel for water heating, kWh/month													
	199.6009	175.1196	182.0880	160.8777	156.7497	138.8278	130.3257	147.1641	148.2179	167.1351	179.5477	193.7480	(219)
Water heating fuel used												1979.4022	(219)
Annual totals kWh/year													
Space heating fuel - main system												3443.3463	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5966.3303	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3443.3463	3.9200	134.9792	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4022	3.9200	77.5926	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			392.7632	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3443.3463	0.2160	743.7628	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4022	0.2160	427.5509	(264)
Space and water heating			1171.3137	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1453.4326	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3443.3463	1.2200	4200.8825	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4022	1.2200	2414.8707	(264)
Space and water heating			6615.7533	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8284.5492	(272)
Primary energy kWh/m2/year			76.4116	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-191 kg (13.2%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (75.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 94	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£301	£261	£39
Space heating	£236	£236	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£393	£53	£340
Total cost of uses	£393	£53	£340
Delivered energy	55 kWh/m²	29 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	76 kWh/m²	15 kWh/m²	62 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.2373	123.9176	123.6043	122.1323	121.8570	120.5750	120.5750	120.3376	121.0688	121.8570	122.4141	122.9965	(39)
Average = Sum(39)m / 12 =												122.1310	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1429	1.1401	1.1265	1.1239	1.1121	1.1121	1.1099	1.1167	1.1239	1.1291	1.1344	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
										Solar input (sum of months) = Sum(63)m =		-874.6850	(63)
Output from w/h													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
										Total per year (kWh/year) = Sum(64)m =		885.6514	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	84.3644	164.6145	272.0280	401.2021	497.5866	512.4310	486.5667	413.6669	317.5666	195.3963	105.0692	69.4823	(83)
Total gains	744.7645	819.4342	900.4892	989.0594	1043.7604	1021.8105	974.9383	911.8483	839.5949	758.2592	713.0338	711.6691	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1271	33.2126	33.2968	33.6981	33.7743	34.1333	34.1333	34.2007	33.9941	33.7743	33.6205	33.4613	
alpha	3.2085	3.2142	3.2198	3.2465	3.2516	3.2756	3.2756	3.2800	3.2663	3.2516	3.2414	3.2308	
util living area													
	0.9757	0.9654	0.9426	0.8903	0.7952	0.6498	0.5077	0.5544	0.7637	0.9148	0.9645	0.9788	(86)
MIT	19.1778	19.3712	19.7226	20.1882	20.5875	20.8529	20.9514	20.9345	20.7353	20.2197	19.6230	19.1425	(87)
Th 2	19.9635	19.9659	19.9683	19.9793	19.9813	19.9910	19.9910	19.9927	19.9872	19.9813	19.9772	19.9728	(88)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9712	0.9589	0.9314	0.8678	0.7517	0.5746	0.4049	0.4517	0.6995	0.8926	0.9566	0.9748	(89)
MIT 2	17.5429	17.8237	18.3302	18.9942	19.5341	19.8654	19.9627	19.9517	19.7368	19.0523	18.1983	17.4975	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.7673	18.0361	18.5213	19.1581	19.6787	20.0009	20.0984	20.0866	19.8739	19.2125	18.3938	17.7233	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6173	17.8861	18.3713	19.0081	19.5287	19.8509	19.9484	19.9366	19.7239	19.0625	18.2438	17.5733	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9405	0.9081	0.8413	0.7293	0.5632	0.4003	0.4455	0.6801	0.8665	0.9377	0.9610	(94)
Useful gains	711.9985	770.6396	817.7258	832.0691	761.2339	575.4675	390.2485	406.2030	571.0179	657.0132	668.6446	683.9147	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1654.5004	1609.2088	1467.3432	1234.5230	953.9764	633.1264	403.7349	425.5863	680.8745	1031.2199	1364.1623	1644.8643	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	701.2214	563.5185	483.3154	289.7669	143.4004	0.0000	0.0000	0.0000	0.0000	278.4098	500.7727	714.9465	(98)
Space heating												3675.3515	(98)
Space heating per m2											(98) / (4) =	33.8992	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4061.1619	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	701.2214	563.5185	483.3154	289.7669	143.4004	0.0000	0.0000	0.0000	0.0000	278.4098	500.7727	714.9465	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	774.8302	622.6723	534.0501	320.1844	158.4535	0.0000	0.0000	0.0000	0.0000	307.6351	553.3400	789.9961	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9072	89.9421	89.9774	90.0399	90.1067	87.3000	87.3000	87.3000	87.3000	89.6646	89.8182	89.9198	(217)
Fuel for water heating, kWh/month	171.0750	127.6234	101.1444	52.1308	21.5141	4.4162	0.0000	31.2800	57.4574	105.8130	145.6073	169.8652	(219)
Water heating fuel used												987.9269	(219)
Annual totals kWh/year													
Space heating fuel - main system												4061.1619	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3915.4312	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4061.1619	3.4800	141.3284	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	987.9269	3.4800	34.3799	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			146.1788	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4002	(257)
SAP value		94.4175	
SAP rating (Section 12)		94	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4061.1619	0.2160	877.2110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	987.9269	0.2160	213.3922	(264)
Space and water heating			1090.6032	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			502.2349	(272)
CO2 emissions per m2			4.6300	(273)
EI value			95.6134	
EI rating			96	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.5879	121.0688	121.0688	120.3376	120.3376	119.4513	119.6633	119.2455	119.4513	119.8817	119.8817	120.5750	(39)
Average = Sum(39)m / 12 =												120.2125	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1167	1.1167	1.1099	1.1099	1.1017	1.1037	1.0998	1.1017	1.1057	1.1057	1.1121	(40)
HLP (average)												1.1088	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	95.8285	168.3650	274.7043	416.7539	502.6801	553.5632	520.1174	452.8438	347.3909	213.3805	122.3010	78.1363	(83)
Total gains	756.2286	823.1848	903.1654	1004.6111	1048.8539	1062.9428	1008.4890	951.0252	869.4193	776.2434	730.2656	720.3232	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8490	33.9941	33.9941	34.2007	34.2007	34.4545	34.3934	34.5139	34.4545	34.3307	34.3307	34.1333	
alpha	3.2566	3.2663	3.2663	3.2800	3.2800	3.2970	3.2929	3.3009	3.2970	3.2887	3.2887	3.2756	
util living area													
	0.9708	0.9601	0.9312	0.8618	0.7325	0.5217	0.3591	0.3892	0.6740	0.8855	0.9543	0.9743	(86)
MIT	19.3679	19.5360	19.9021	20.3582	20.7345	20.9415	20.9879	20.9843	20.8537	20.3991	19.8220	19.3413	(87)
Th 2	19.9834	19.9872	19.9872	19.9927	19.9927	19.9994	19.9978	20.0010	19.9994	19.9962	19.9962	19.9910	(88)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

util rest of house												
	0.9652	0.9525	0.9174	0.8332	0.6761	0.4311	0.2470	0.2731	0.5911	0.8551	0.9439	0.9693 (89)
MIT 2	17.8308	18.0752	18.5990	19.2377	19.7281	19.9604	19.9939	19.9955	19.8803	19.3097	18.4966	17.7976 (90)
Living area fraction										fLA = Living area / (4) =		0.1372 (91)
MIT	18.0417	18.2756	18.7778	19.3915	19.8662	20.0951	20.1303	20.1312	20.0139	19.4592	18.6785	18.0095 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8917	18.1256	18.6278	19.2415	19.7162	19.9451	19.9803	19.9812	19.8639	19.3092	18.5285	17.8595 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9485	0.9329	0.8930	0.8075	0.6587	0.4259	0.2450	0.2707	0.5785	0.8288	0.9229	0.9539	(94)
Useful gains	717.3038	767.9506	806.5527	811.1765	690.8889	452.7272	247.0643	257.4726	502.9792	643.3340	673.9860	687.1305	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1555.3216	1516.4646	1359.3407	1124.1297	808.2119	471.2417	248.9410	260.0995	557.1112	924.1915	1262.1759	1538.4721	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	623.4853	503.0014	411.2743	225.3263	87.2883	0.0000	0.0000	0.0000	0.0000	208.9579	423.4968	633.3982	(98)
Space heating												3116.2284	(98)
Space heating per m2											(98) / (4) =	28.7422	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3443.3463	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	623.4853	503.0014	411.2743	225.3263	87.2883	0.0000	0.0000	0.0000	0.0000	208.9579	423.4968	633.3982	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	688.9340	555.8027	454.4467	248.9793	96.4512	0.0000	0.0000	0.0000	0.0000	230.8928	467.9522	699.8875	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8554	89.8833	89.8893	89.9266	89.8135	87.3000	87.3000	87.3000	87.3000	89.4926	89.7389	89.8652	(217)
Fuel for water heating, kWh/month													
	168.8347	128.8691	104.0948	52.7607	25.6079	0.0000	0.0000	25.5558	53.3022	103.4892	142.0590	168.2659	(219)
Water heating fuel used												972.8392	(219)
Annual totals kWh/year													
Space heating fuel - main system												3443.3463	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3185.6077	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3443.3463	3.9200	134.9792	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	972.8392	3.9200	38.1353	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			52.4085	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy	Emission factor	Emissions	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3443.3463	0.2160	743.7628	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8392	0.2160	210.1333	(264)
Space and water heating			953.8961	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			315.2262	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3443.3463	1.2200	4200.8825	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	972.8392	1.2200	1186.8638	(264)
Space and water heating			5387.7464	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1609.8722	(272)
Primary energy kWh/m2/year			14.8485	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.61	(37)
Summer heat loss coefficient	440.75	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						607.9295

	Jun	Jul	Aug	
Solar gains	647	608	529	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1153	1093	1024	(P5)
Summer gain/loss ratio	2.62	2.48	2.32	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.66	21.42	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-p637-6633-314	**Issued on Date**	19/10/2022
Assessment Reference	Plot 314	**Prop Type Ref**	3T-Opp-SEMI
Property	Plot 314, 3 Bed, K, WC, B, Ut		

SAP Rating	85 B	**DER**	15.79	**TER**	17.43
Environmental	86 B	**% DER<TER**	9.41		
CO_2 Emissions (t/year)	1.43	**DFEE**	46.07	**TFEE**	54.00
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.69		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 108 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.79 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.1 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.12 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 6.67 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1067	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3572	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.2373	123.9176	123.6043	122.1323	121.8570	120.5750	120.5750	120.3376	121.0688	121.8570	122.4141	122.9965	(39)
Average = Sum(39)m / 12 =												122.1310	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1429	1.1401	1.1265	1.1239	1.1121	1.1121	1.1099	1.1167	1.1239	1.1291	1.1344	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
									Total per year (kWh/year) = Sum(64)m =			1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	442.3169	439.8102	423.5211	397.2842	370.4157	344.9147	328.6523	335.3884	349.1659	375.6335	405.9202	428.8492	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	558.2806	653.6337	750.6693	846.4031	903.1331	884.0839	844.3832	788.9917	719.5478	622.1190	547.9961	525.9194	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1271	33.2126	33.2968	33.6981	33.7743	34.1333	34.1333	34.2007	33.9941	33.7743	33.6205	33.4613	
alpha	3.2085	3.2142	3.2198	3.2465	3.2516	3.2756	3.2756	3.2800	3.2663	3.2516	3.2414	3.2308	
util living area	0.9891	0.9812	0.9638	0.9228	0.8432	0.7116	0.5692	0.6177	0.8192	0.9471	0.9826	0.9910	(86)
MIT	18.9420	19.1686	19.5530	20.0530	20.4943	20.8055	20.9319	20.9096	20.6648	20.0776	19.4203	18.9046	(87)
Th 2	19.9635	19.9659	19.9683	19.9793	19.9813	19.9910	19.9910	19.9927	19.9872	19.9813	19.9772	19.9728	(88)
util rest of house	0.9870	0.9775	0.9562	0.9055	0.8053	0.6381	0.4599	0.5107	0.7620	0.9318	0.9785	0.9892	(89)
MIT 2	17.2018	17.5327	18.0905	18.8112	19.4199	19.8192	19.9499	19.9339	19.6589	18.8588	17.9081	17.1529	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.4406	17.7572	18.2912	18.9816	19.5674	19.9546	20.0847	20.0678	19.7969	19.0261	18.1156	17.3933	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2906	17.6072	18.1412	18.8316	19.4174	19.8046	19.9347	19.9178	19.6469	18.8761	17.9656	17.2433	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9780	0.9645	0.9371	0.8800	0.7800	0.6227	0.4533	0.5019	0.7385	0.9086	0.9660	0.9815	(94)
Useful gains	546.0260	630.4114	703.4501	744.8371	704.4640	550.4869	382.7336	395.9667	531.4070	565.2837	529.3709	516.2042	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1613.9172	1574.6446	1438.8983	1212.9736	940.4151	627.5425	402.0807	423.3262	671.5592	1008.4976	1330.1053	1604.2767	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	794.5111	634.5247	547.1734	337.0583	175.5476	0.0000	0.0000	0.0000	0.0000	329.7511	576.5287	809.5259	(98)
Space heating												4204.6208	(98)
Space heating per m2											(98) / (4) =	38.7809	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4645.9898	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	794.5111	634.5247	547.1734	337.0583	175.5476	0.0000	0.0000	0.0000	0.0000	329.7511	576.5287	809.5259	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	877.9128	701.1322	604.6115	372.4401	193.9752	0.0000	0.0000	0.0000	0.0000	364.3659	637.0483	894.5038	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8937	89.8464	89.7446	89.5199	89.0589	87.3000	87.3000	87.3000	87.3000	89.4793	89.7821	89.9170	(217)
Fuel for water heating, kWh/month													
	199.3164	174.8680	181.7291	160.3517	155.7810	138.8278	130.3257	147.1641	148.2179	166.5014	179.1755	193.4761	(219)
Water heating fuel used												1975.7347	(219)
Annual totals kWh/year													
Space heating fuel - main system												4645.9898	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7165.3063	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4645.9898	0.2160	1003.5338	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1975.7347	0.2160	426.7587	(264)
Space and water heating			1430.2925	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/year			1712.4114	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.7900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.7900	ZC1
Total Floor Area	TFA	108.4200	
Assumed number of occupants	N	2.8050	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.7170	ZC2
CO2 emissions from cooking, equation (L16)		1.7185	ZC3
Total CO2 emissions		32.2255	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2255	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4859	(36)
Total fabric heat loss (33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050 (42)
Average daily hot water use (litres/day)	100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.7245	48.2936	44.7470	46.2385	48.2936	48.7245	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
									Total per year (kWh/year) = Sum(64)m =			2170.4720	(64)
Heat gains from water heating, kWh/month													
	67.4235	59.3336	62.0927	55.2082	53.3589	46.8130	44.5726	49.9563	50.5164	57.4158	61.0962	65.6980	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	90.6230	88.2941	83.4579	76.6781	71.7190	65.0181	59.9094	67.1455	70.1617	77.1718	84.8559	88.3038	(72)
Total internal gains													
	454.4972	451.9958	435.7176	409.2920	381.7475	355.5734	339.3214	346.7300	361.1883	387.8441	418.1135	441.0347	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	554.5537	636.4883	717.9896	796.8035	841.3901	820.7826	784.3075	738.1108	680.7634	600.5183	540.7003	524.7894	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9991	0.9979	0.9941	0.9793	0.9305	0.8031	0.6342	0.6889	0.9059	0.9881	0.9980	0.9993	(86)
MIT	19.7043	19.8434	20.0858	20.4149	20.7128	20.9160	20.9810	20.9711	20.8237	20.4323	20.0127	19.6865	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9987	0.9971	0.9918	0.9707	0.8992	0.7195	0.5054	0.5622	0.8512	0.9817	0.9972	0.9991	(89)
MIT 2	18.2388	18.4441	18.7997	19.2844	19.6976	19.9492	20.0028	19.9996	19.8511	19.3156	18.7018	18.2207	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4399	18.6361	18.9762	19.4396	19.8369	20.0819	20.1371	20.1329	19.9846	19.4688	18.8818	18.4218	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9885	0.9641	0.8929	0.7263	0.5229	0.5789	0.8497	0.9767	0.9958	0.9985	(94)
Useful gains	553.4178	633.6878	709.7482	768.2142	751.2488	596.1484	410.0770	427.2945	578.4739	586.5456	538.4049	523.9823	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1730.6984	1675.9777	1517.5382	1263.2685	972.5832	646.7565	417.3087	439.3430	697.7738	1060.0663	1416.1566	1719.4423	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating												4572.1260	(98)
Space heating per m2											(98) / (4) =	42.1705	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4895.2099	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	875.8968	700.4188	600.9958	356.4391	164.6727	0.0000	0.0000	0.0000	0.0000	352.2994	631.9812	889.4222	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	937.7910	749.9131	643.4644	381.6264	176.3092	0.0000	0.0000	0.0000	0.0000	377.1942	676.6394	952.2722	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	215.4214	189.8673	199.3889	178.1293	172.4606	151.8937	145.5257	162.2270	164.0187	185.3232	195.9842	210.2321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2099	88.0384	87.6535	86.7636	84.9351	80.3000	80.3000	80.3000	80.3000	86.6434	87.7864	88.2773	(217)
Fuel for water heating, kWh/month													
	244.2145	215.6641	227.4739	205.3043	203.0498	189.1577	181.2275	202.0262	204.2574	213.8918	223.2512	238.1497	(219)
Water heating fuel used												2547.6682	(219)
Annual totals kWh/year													
Space heating fuel - main system												4895.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												7986.4598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4895.2099	0.2160	1057.3653	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.6682	0.2160	550.2963	(264)
Space and water heating			1607.6617	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total CO2, kg/m2/year			1889.7806	(272)
Emissions per m2 for space and water heating			14.8281	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2431	(272b)
Emissions per m2 for pumps and fans			0.3590	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8281 * 1.00) + 2.2431 + 0.3590, rounded to 2 d.p.			17.4300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3928	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3633	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4632	0.4541	0.4451	0.3996	0.3906	0.3451	0.3451	0.3361	0.3633	0.3906	0.4087	0.4269	(22b)
Effective ac	0.6073	0.6031	0.5990	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5835	0.5911	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			9.0000	223.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14593.2390	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.5991	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3465	55.9599	55.5811	53.8014	53.4685	51.9185	51.9185	51.6314	52.5155	53.4685	54.1421	54.8462	(38)
Heat transfer coeff	125.9585	125.5720	125.1931	123.4135	123.0805	121.5305	121.5305	121.2435	122.1276	123.0805	123.7541	124.4583	(39)
Average = Sum(39)m / 12 =												123.4119	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1618	1.1582	1.1547	1.1383	1.1352	1.1209	1.1209	1.1183	1.1264	1.1352	1.1414	1.1479	(40)
HLP (average)												1.1383	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8050 (42)
Average daily hot water use (litres/day) 100.8188 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	523.8114	620.0103	718.8022	816.9252	875.2104	858.3477	820.5011	762.7293	692.4362	592.5347	515.6213	492.2924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1826	32.2817	32.3794	32.8463	32.9352	33.3552	33.3552	33.4342	33.1922	32.9352	32.7559	32.5706	
alpha	3.1455	3.1521	3.1586	3.1898	3.1957	3.2237	3.2237	3.2289	3.2128	3.1957	3.1837	3.1714	
util living area	0.9905	0.9832	0.9669	0.9281	0.8522	0.7244	0.5834	0.6338	0.8314	0.9523	0.9848	0.9922	(86)
MIT	18.8459	19.0784	19.4741	19.9940	20.4538	20.7854	20.9229	20.8977	20.6334	20.0196	19.3423	18.8130	(87)
Th 2	19.9507	19.9536	19.9564	19.9697	19.9722	19.9838	19.9838	19.9859	19.9793	19.9722	19.9671	19.9619	(88)
util rest of house	0.9886	0.9798	0.9599	0.9118	0.8158	0.6516	0.4727	0.5260	0.7763	0.9384	0.9812	0.9906	(89)
MIT 2	17.9749	18.2080	18.6016	19.1194	19.5555	19.8531	19.9516	19.9397	19.7314	19.1537	18.4816	17.9502	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0944	18.3274	18.7213	19.2395	19.6788	19.9810	20.0849	20.0712	19.8552	19.2726	18.5997	18.0686	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0944	18.3274	18.7213	19.2395	19.6788	19.9810	20.0849	20.0712	19.8552	19.2726	18.5997	18.0686	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9726	0.9490	0.8974	0.8035	0.6513	0.4846	0.5360	0.7683	0.9259	0.9745	0.9866	(94)
Useful gains	515.3324	603.0031	682.1649	733.1220	703.2541	559.0740	397.6322	408.8260	531.9990	548.6331	502.4559	485.6725	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1737.5231	1686.1104	1530.0259	1276.0296	982.0357	653.9593	423.5238	445.1108	702.8710	1067.4230	1423.1404	1726.0647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	909.3099	727.8481	630.8086	390.8935	207.4135	0.0000	0.0000	0.0000	0.0000	385.9797	662.8929	922.8518	(98)
Space heating												4837.9979	(98)
Space heating per m2											(98) / (4) =	44.6227	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1142.3869	899.3259	921.4505	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7535	0.8240	0.7945	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	860.7815	741.0315	732.1037	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.8411	1067.2919	1002.1047	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	182.2029	242.7378	200.8808	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												625.8215	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	45.5507	60.6844	50.2202	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												156.4554	(107)
Space cooling per m2												1.4430	(108)
Energy for space heating												44.6227	(99)
Energy for space cooling												1.4430	(108)
Total												46.0658	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1423	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3923	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3628	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4626	0.4536	0.4445	0.3991	0.3901	0.3447	0.3447	0.3356	0.3628	0.3901	0.4082	0.4263	(22b)
Effective ac	0.6070	0.6029	0.5988	0.5797	0.5761	0.5594	0.5594	0.5563	0.5658	0.5761	0.5833	0.5909	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			13.2600	1.3258	17.5795			(27)
GF B&B J150 P/A=0.40			41.8200	0.1300	5.4366			(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.1800	13.6386			(29a)
Wall to Void	19.4200		19.4200	0.1800	3.4956			(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.1800	0.5112			(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.1800	3.2256			(29a)
Plane Ceiling	12.8300		12.8300	0.1300	1.6679			(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.1300	0.3146			(30)
Sloping	14.0000		14.0000	0.1300	1.8200			(30)
Ceiling to void	17.0400		17.0400	0.1300	2.2152			(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.5908			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4859	(36)
Total fabric heat loss	(33) + (36) =	66.0767	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.3212	55.9356	55.5577	53.7826	53.4505	51.9044	51.9044	51.6181	52.4999	53.4505	54.1223	54.8247	(38)
Heat transfer coeff	122.3979	122.0123	121.6344	119.8593	119.5272	117.9812	117.9812	117.6949	118.5767	119.5272	120.1991	120.9015	(39)
Average = Sum(39)m / 12 =												119.8577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1289	1.1254	1.1219	1.1055	1.1024	1.0882	1.0882	1.0855	1.0937	1.1024	1.1086	1.1151	(40)
HLP (average)												1.1055	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8050	(42)
Average daily hot water use (litres/day)	100.8188	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.9483	30.5660	31.5414	27.4985	26.3855	22.7687	21.0985	24.2109	24.5000	28.5524	31.1672	33.8455	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	140.2501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5330	23.5664	19.1655	14.5095	10.8460	9.1567	9.8941	12.8607	17.2617	21.9176	25.5811	27.2705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	269.2661	272.0603	265.0191	250.0294	231.1075	213.3236	201.4429	198.6487	205.6899	220.6796	239.6015	257.3854	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	37.0250	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	46.9735	45.4851	42.3943	38.1924	35.4644	31.6232	28.3582	32.5415	34.0278	38.3769	43.2878	45.4913	(72)
Total internal gains													
	407.8477	406.1868	391.6540	367.8063	342.4929	319.1785	304.7702	309.1260	322.0544	346.0492	373.5454	395.2222	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.6300	0.7000	0.7700	24.7296	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	6.6700	19.6403	0.6300	0.7000	0.7700	40.0355	(80)

Solar gains	100.0565	184.4925	282.2720	387.5115	459.6425	465.2093	444.9861	391.3808	319.5751	212.6742	122.5868	83.7547	(83)
Total gains	507.9042	590.6793	673.9260	755.3178	802.1354	784.3877	749.7563	700.5068	641.6295	558.7234	496.1322	478.9769	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5139	61.7082	61.9000	62.8167	62.9912	63.8167	63.8167	63.9719	63.4962	62.9912	62.6391	62.2752	
alpha	5.1009	5.1139	5.1267	5.1878	5.1994	5.2544	5.2544	5.2648	5.2331	5.1994	5.1759	5.1517	
util living area													
	0.9994	0.9985	0.9955	0.9835	0.9412	0.8237	0.6581	0.7164	0.9225	0.9913	0.9987	0.9996	(86)
MIT	19.6640	19.8039	20.0485	20.3822	20.6884	20.9045	20.9775	20.9653	20.8020	20.3978	19.9742	19.6467	(87)
Th 2	19.9773	19.9802	19.9830	19.9963	19.9988	20.0105	20.0105	20.0127	20.0060	19.9988	19.9938	19.9885	(88)
util rest of house													
	0.9992	0.9980	0.9938	0.9763	0.9134	0.7429	0.5270	0.5890	0.8739	0.9865	0.9981	0.9994	(89)
MIT 2	18.7500	18.8921	19.1382	19.4789	19.7723	19.9618	20.0042	20.0016	19.8838	19.4988	19.0733	18.7417	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8754	19.0172	19.2632	19.6028	19.8980	20.0912	20.1377	20.1339	20.0098	19.6222	19.1970	18.8659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9972	0.9921	0.9726	0.9099	0.7505	0.5450	0.6061	0.8742	0.9839	0.9975	0.9991	(94)
Useful gains	507.3053	589.0475	668.6042	734.6406	729.8376	588.6771	408.6389	424.5913	560.8911	549.7549	494.8795	478.5645	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1784.0020	1722.4760	1552.4396	1282.8340	979.8828	647.8564	417.3865	439.4567	700.7702	1078.3989	1454.0429	1773.1336	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	949.8623	761.6639	657.5735	394.6993	186.0336	0.0000	0.0000	0.0000	0.0000	393.3112	690.5977	963.1594	(98)
Space heating												4996.9010	(98)
Space heating per m2											(98) / (4) =	46.0884	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1109.0230	873.0606	894.4810	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8063	0.8861	0.8560	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.2595	773.5781	765.6862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3944	984.6031	929.3771	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	95.8571	157.0026	121.7861	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												374.6458	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	23.9643	39.2507	30.4465	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												93.6614	(107)
Space cooling per m2												0.8639	(108)
Energy for space heating												46.0884	(99)
Energy for space cooling												0.8639	(108)
Total												46.9522	(109)
Target Fabric Energy Efficiency (TFEE)												54.0	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067 (8)
Pressure test				Yes
Measured/design AP50				5.0100
Infiltration rate				0.3572 (18)
Number of sides sheltered				1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =		0.3304 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654 (36)
Total fabric heat loss	(33) + (36) =	69.6120 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.5879	121.0688	121.0688	120.3376	120.3376	119.4513	119.6633	119.2455	119.4513	119.8817	119.8817	120.5750	(39)
Average = Sum(39)m / 12 =												120.2125	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1167	1.1167	1.1099	1.1099	1.1017	1.1037	1.0998	1.1017	1.1057	1.1057	1.1121	(40)
HLP (average)												1.1088	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
RHI water heating demand												1758	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8490	33.9941	33.9941	34.2007	34.2007	34.4545	34.3934	34.5139	34.4545	34.3307	34.3307	34.1333	
alpha	3.2566	3.2663	3.2663	3.2800	3.2800	3.2970	3.2929	3.3009	3.2970	3.2887	3.2887	3.2756	
util living area	0.9672	0.9539	0.9215	0.8491	0.7205	0.5119	0.3503	0.3750	0.6483	0.8686	0.9475	0.9713	(86)
MIT	19.4090	19.5906	19.9548	20.3929	20.7480	20.9447	20.9888	20.9860	20.8702	20.4431	19.8681	19.3776	(87)
Th 2	19.9834	19.9872	19.9872	19.9927	19.9927	19.9994	19.9978	20.0010	19.9994	19.9962	19.9962	19.9910	(88)
util rest of house	0.9609	0.9452	0.9062	0.8189	0.6635	0.4223	0.2407	0.2626	0.5652	0.8353	0.9358	0.9658	(89)
MIT 2	17.8897	18.1527	18.6720	19.2826	19.7430	19.9627	19.9942	19.9961	19.8952	19.3662	18.5613	17.8497	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0982	18.3500	18.8481	19.4350	19.8809	20.0975	20.1307	20.1320	20.0290	19.5140	18.7407	18.0594	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9482	18.2000	18.6981	19.2850	19.7309	19.9475	19.9807	19.9820	19.8790	19.3640	18.5907	17.9094	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8810	0.7936	0.6469	0.4174	0.2387	0.2604	0.5541	0.8093	0.9137	0.9494	(94)
Useful gains	745.4240	804.7175	841.1039	832.9668	698.6909	454.0786	247.2505	257.8534	511.1442	670.5015	704.5236	711.9820	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	1562.1887	1525.4707	1367.8413	1129.3660	809.9799	471.5319	248.9856	260.1890	558.9167	930.7639	1269.6266	1544.4887	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	607.6729	484.3462	391.8926	213.4075	82.7990	0.0000	0.0000	0.0000	0.0000	193.6352	406.8742	619.3850	(98)
Space heating												3000.0126	(98)
RHI space heating demand												3000	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200	(1b)	x 2.5400	(2b) =	106.2228	(1b) - (3b)
First floor	41.8200	(1c)	x 2.6900	(2c) =	112.4958	(1c) - (3c)
Second floor	24.7800	(1d)	x 2.5200	(2d) =	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.2373	123.9176	123.6043	122.1323	121.8570	120.5750	120.5750	120.3376	121.0688	121.8570	122.4141	122.9965	(39)
Average = Sum(39)m / 12 =												122.1310	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1429	1.1401	1.1265	1.1239	1.1121	1.1121	1.1099	1.1167	1.1239	1.1291	1.1344	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
								Total per year (kWh/year) = Sum(64)m =				1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1271	33.2126	33.2968	33.6981	33.7743	34.1333	34.1333	34.2007	33.9941	33.7743	33.6205	33.4613	
alpha	3.2085	3.2142	3.2198	3.2465	3.2516	3.2756	3.2756	3.2800	3.2663	3.2516	3.2414	3.2308	
util living area	0.9729	0.9598	0.9337	0.8786	0.7832	0.6385	0.4954	0.5360	0.7397	0.9012	0.9594	0.9765	(86)
MIT	19.2165	19.4289	19.7814	20.2297	20.6079	20.8605	20.9548	20.9407	20.7611	20.2684	19.6663	19.1768	(87)
Th 2	19.9635	19.9659	19.9683	19.9793	19.9813	19.9910	19.9910	19.9927	19.9872	19.9813	19.9772	19.9728	(88)
util rest of house	0.9678	0.9524	0.9211	0.8545	0.7386	0.5634	0.3942	0.4350	0.6736	0.8766	0.9507	0.9721	(89)
MIT 2	17.5985	17.9059	18.4125	19.0496	19.5585	19.8725	19.9649	19.9560	19.7644	19.1173	18.2598	17.5469	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	17.8205	18.1149	18.6004	19.2115	19.7025	20.0081	20.1007	20.0912	19.9012	19.2752	18.4529	17.7706	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6705	17.9649	18.4504	19.0615	19.5525	19.8581	19.9507	19.9412	19.7512	19.1252	18.3029	17.6206	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8967	0.8280	0.7170	0.5526	0.3899	0.4294	0.6559	0.8500	0.9306	0.9574	(94)
Useful gains	738.8087	809.9696	856.8792	858.6617	773.5987	579.4086	391.5196	408.7107	585.3385	687.9431	697.9528	707.7429	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	1661.1190	1618.9775	1477.1185	1241.0524	956.8868	633.9944	404.0131	426.1351	684.1784	1038.8595	1371.3896	1650.6875 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	686.1988	543.6534	461.4581	275.3213	136.3663	0.0000	0.0000	0.0000	0.0000	261.0818	484.8745	701.5507 (98)
Space heating												3550.5050 (98)
Space heating per m2											(98) / (4) =	32.7477 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3923.2099	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	686.1988	543.6534	461.4581	275.3213	136.3663	0.0000	0.0000	0.0000	0.0000	261.0818	484.8745	701.5507	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	758.2307	600.7219	509.8984	304.2225	150.6810	0.0000	0.0000	0.0000	0.0000	288.4882	535.7729	775.1942	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8183	89.7623	89.6419	89.3773	88.8574	87.3000	87.3000	87.3000	87.3000	89.3106	89.6811	89.8456	(217)
Fuel for water heating, kWh/month													
	199.4835	175.0317	181.9373	160.6076	156.1343	138.8278	130.3257	147.1641	148.2179	166.8159	179.3772	193.6298	(219)
Water heating fuel used												1977.5530	(219)
Annual totals kWh/year													
Space heating fuel - main system												3923.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												6444.3446	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3923.2099	3.4800	136.5277	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1977.5530	3.4800	68.8188	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Total energy cost			397.0450	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0869	(257)
SAP value		84.8371	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3923.2099	0.2160	847.4133	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.5530	0.2160	427.1514	(264)
Space and water heating			1274.5648	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1556.6837	(272)
CO2 emissions per m2			14.3600	(273)
EI value			86.4036	
EI rating			86	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9654	(36)
Total fabric heat loss					(33) + (36) =		69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.5879	121.0688	121.0688	120.3376	120.3376	119.4513	119.6633	119.2455	119.4513	119.8817	119.8817	120.5750	(39)
Average = Sum(39)m / 12 =												120.2125	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1167	1.1167	1.1099	1.1099	1.1017	1.1037	1.0998	1.1017	1.1057	1.1057	1.1121	(40)
HLP (average)												1.1088	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
									Total per year (kWh/year) = Sum(64)m =			1758.3202	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8490	33.9941	33.9941	34.2007	34.2007	34.4545	34.3934	34.5139	34.4545	34.3307	34.3307	34.1333	
alpha	3.2566	3.2663	3.2663	3.2800	3.2800	3.2970	3.2929	3.3009	3.2970	3.2887	3.2887	3.2756	
util living area	0.9672	0.9539	0.9215	0.8491	0.7205	0.5119	0.3503	0.3750	0.6483	0.8686	0.9475	0.9713	(86)
MIT	19.4090	19.5906	19.9548	20.3929	20.7480	20.9447	20.9888	20.9860	20.8702	20.4431	19.8681	19.3776	(87)
Th 2	19.9834	19.9872	19.9872	19.9927	19.9927	19.9994	19.9978	20.0010	19.9994	19.9962	19.9962	19.9910	(88)
util rest of house	0.9609	0.9452	0.9062	0.8189	0.6635	0.4223	0.2407	0.2626	0.5652	0.8353	0.9358	0.9658	(89)
MIT 2	17.8897	18.1527	18.6720	19.2826	19.7430	19.9627	19.9942	19.9961	19.8952	19.3662	18.5613	17.8497	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.0982	18.3500	18.8481	19.4350	19.8809	20.0975	20.1307	20.1320	20.0290	19.5140	18.7407	18.0594	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9482	18.2000	18.6981	19.2850	19.7309	19.9475	19.9807	19.9820	19.8790	19.3640	18.5907	17.9094	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8810	0.7936	0.6469	0.4174	0.2387	0.2604	0.5541	0.8093	0.9137	0.9494	(94)
Useful gains	745.4240	804.7175	841.1039	832.9668	698.6909	454.0786	247.2505	257.8534	511.1442	670.5015	704.5236	711.9820	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	1562.1887	1525.4707	1367.8413	1129.3660	809.9799	471.5319	248.9856	260.1890	558.9167	930.7639	1269.6266	1544.4887 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	607.6729	484.3462	391.8926	213.4075	82.7990	0.0000	0.0000	0.0000	0.0000	193.6352	406.8742	619.3850 (98)
Space heating												3000.0126 (98)
Space heating per m2											(98) / (4) =	27.6703 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3314.9310 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	607.6729	484.3462	391.8926	213.4075	82.7990	0.0000	0.0000	0.0000	0.0000	193.6352	406.8742	619.3850	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	671.4618	535.1892	433.0305	235.8093	91.4906	0.0000	0.0000	0.0000	0.0000	213.9616	449.5847	684.4033	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7509	89.6947	89.5355	89.1854	88.4692	87.3000	87.3000	87.3000	87.3000	89.0801	89.5697	89.7784	(217)
Fuel for water heating, kWh/month													
	199.6335	175.1636	182.1535	160.9532	156.8195	138.8278	130.3257	147.1641	148.2179	167.2475	179.6002	193.7748	(219)
Water heating fuel used												1979.8814	(219)
Annual totals kWh/year													
Space heating fuel - main system												3314.9310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Total delivered energy for all uses												5838.3942	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3314.9310	3.9200	129.9453	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.8814	3.9200	77.6114	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Total energy cost			387.7481	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3314.9310	0.2160	716.0251	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8814	0.2160	427.6544	(264)
Space and water heating			1143.6795	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Total kg/year			1425.7984	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3314.9310	1.2200	4044.2159	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.8814	1.2200	2415.4554	(264)
Space and water heating			6459.6712	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Primary energy kWh/year			8128.4672	(272)
Primary energy kWh/m2/year			74.9720	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-192 kg (13.4%)
U Solar photovoltaic panels	+ 8.7	-£ 309	-947 kg (76.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.77 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.73 kg/m²	A 95	A 96
Total Savings	£340	10.50 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£92	£101	-£8
Mains gas	£296	£256	£39
Space heating	£231	£231	£0
Water heating	£78	£47	£31
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£388	£48	£340
Total cost of uses	£388	£48	£340
Delivered energy	54 kWh/m²	28 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	13 kWh/m²	62 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4213	0.4130	0.4048	0.3635	0.3552	0.3139	0.3139	0.3056	0.3304	0.3552	0.3717	0.3882	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5493	0.5493	0.5467	0.5546	0.5631	0.5691	0.5754	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.6253	54.3056	53.9922	52.5203	52.2449	50.9629	50.9629	50.7255	51.4567	52.2449	52.8020	53.3845	(38)
Heat transfer coeff	124.2373	123.9176	123.6043	122.1323	121.8570	120.5750	120.5750	120.3376	121.0688	121.8570	122.4141	122.9965	(39)
Average = Sum(39)m / 12 =												122.1310	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1459	1.1429	1.1401	1.1265	1.1239	1.1121	1.1121	1.1099	1.1167	1.1239	1.1291	1.1344	(40)
HLP (average)												1.1265	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1433	(H8)
Utilisation factor												0.5830	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-874.6850	(H17)
Solar input	-25.3641	-42.3254	-72.0850	-96.6082	-119.3513	-117.3413	-115.7906	-101.1668	-79.2339	-54.1074	-30.0855	-21.2254	(63)
									Solar input (sum of months) = Sum(63)m =			-874.6850	(63)
Output from w/h	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
									Total per year (kWh/year) = Sum(64)m =			885.6514	(64)
Heat gains from water heating, kWh/month	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	19.6403	0.4600	0.0000	0.7700	28.6611	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	6.6700	19.6403	0.4600	0.0000	0.7700	46.4004	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	115.9637	213.8235	327.1482	449.1189	532.7175	539.1692	515.7309	453.6033	370.3819	246.4856	142.0759	97.0702	(83)
Total gains	776.3638	868.6432	955.6094	1036.9761	1078.8913	1048.5488	1004.1025	951.7848	892.4102	809.3485	750.0405	739.2570	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.1271	33.2126	33.2968	33.6981	33.7743	34.1333	34.1333	34.2007	33.9941	33.7743	33.6205	33.4613	
alpha	3.2085	3.2142	3.2198	3.2465	3.2516	3.2756	3.2756	3.2800	3.2663	3.2516	3.2414	3.2308	
util living area	0.9729	0.9598	0.9337	0.8786	0.7832	0.6385	0.4954	0.5360	0.7397	0.9012	0.9594	0.9765	(86)
MIT	19.2165	19.4289	19.7814	20.2297	20.6079	20.8605	20.9548	20.9407	20.7611	20.2684	19.6663	19.1768	(87)
Th 2	19.9635	19.9659	19.9683	19.9793	19.9813	19.9910	19.9910	19.9927	19.9872	19.9813	19.9772	19.9728	(88)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9678	0.9524	0.9211	0.8545	0.7386	0.5634	0.3942	0.4350	0.6736	0.8766	0.9507	0.9721	(89)
MIT 2	17.5985	17.9059	18.4125	19.0496	19.5585	19.8725	19.9649	19.9560	19.7644	19.1173	18.2598	17.5469	(90)
Living area fraction										fLA = Living area / (4) =		0.1372	(91)
MIT	17.8205	18.1149	18.6004	19.2115	19.7025	20.0081	20.1007	20.0912	19.9012	19.2752	18.4529	17.7706	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6705	17.9649	18.4504	19.0615	19.5525	19.8581	19.9507	19.9412	19.7512	19.1252	18.3029	17.6206	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.9325	0.8967	0.8280	0.7170	0.5526	0.3899	0.4294	0.6559	0.8500	0.9306	0.9574	(94)
Useful gains	738.8087	809.9696	856.8792	858.6617	773.5987	579.4086	391.5196	408.7107	585.3385	687.9431	697.9528	707.7429	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1661.1190	1618.9775	1477.1185	1241.0524	956.8868	633.9944	404.0131	426.1351	684.1784	1038.8595	1371.3896	1650.6875	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	686.1988	543.6534	461.4581	275.3213	136.3663	0.0000	0.0000	0.0000	0.0000	261.0818	484.8745	701.5507	(98)
Space heating												3550.5050	(98)
Space heating per m2											(98) / (4) =	32.7477	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3923.2099	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	686.1988	543.6534	461.4581	275.3213	136.3663	0.0000	0.0000	0.0000	0.0000	261.0818	484.8745	701.5507	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	758.2307	600.7219	509.8984	304.2225	150.6810	0.0000	0.0000	0.0000	0.0000	288.4882	535.7729	775.1942	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	153.8087	114.7871	91.0071	46.9385	19.3857	3.8554	0.0000	27.3075	50.1603	94.8768	130.7819	152.7424	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8966	89.9254	89.9568	90.0194	90.0890	87.3000	87.3000	87.3000	87.3000	89.6244	89.8008	89.9107	(217)
Fuel for water heating, kWh/month													
	171.0950	127.6471	101.1675	52.1427	21.5184	4.4162	0.0000	31.2800	57.4574	105.8605	145.6356	169.8823	(219)
Water heating fuel used												988.1028	(219)
Annual totals kWh/year													
Space heating fuel - main system												3923.2099	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3777.6551	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3923.2099	3.4800	136.5277	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.1028	3.4800	34.3860	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	468.5817	13.1900	61.8059	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			141.3842	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.3871	(257)
SAP value		94.6006	
SAP rating (Section 12)		95	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3923.2099	0.2160	847.4133	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.1028	0.2160	213.4302	(264)
Space and water heating			1060.8436	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			472.4752	(272)
CO2 emissions per m2			4.3600	(273)
EI value			95.8733	
EI rating			96	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.8200 (1b)	x	2.5400 (2b)	=	106.2228	(1b) - (3b)
First floor	41.8200 (1c)	x	2.6900 (2c)	=	112.4958	(1c) - (3c)
Second floor	24.7800 (1d)	x	2.5200 (2d)	=	62.4456	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	281.1642	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1067	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3572	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3304	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3469	0.3304	0.3304	0.3056	0.3056	0.2726	0.2808	0.2643	0.2726	0.2891	0.2891	0.3139	(22b)
Effective ac	0.5602	0.5546	0.5546	0.5467	0.5467	0.5372	0.5394	0.5349	0.5372	0.5418	0.5418	0.5493	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.3000	2.7690			(26a)
Window (Uw = 1.30)			13.2600	1.2357	16.3859			(27)
GF B&B J150 P/A=0.40			41.8200	0.1200	5.0184	75.0000	3136.5000	(28a)
EW Brick AAC015	88.7900	13.0200	75.7700	0.2500	18.9425	52.1000	3947.6170	(29a)
Wall to Void	19.4200		19.4200	0.0800	1.5536	9.0000	174.7800	(29a)
DW GRP PU025	4.3400	1.5000	2.8400	0.4400	1.2496	9.0000	25.5600	(29a)
EW WBoard AAC015	20.9200	3.0000	17.9200	0.2400	4.3008	52.1000	933.6320	(29a)
Plane Ceiling	12.8300		12.8300	0.1600	2.0528	9.0000	115.4700	(30)
PR 400mm MW044 Dormer	2.4200		2.4200	0.2900	0.7018	9.0000	21.7800	(30)
Sloping	14.0000		14.0000	0.1100	1.5400	9.0000	126.0000	(30)
Ceiling to void	17.0400		17.0400	0.0800	1.3632	9.0000	153.3600	(30)
Total net area of external elements Aum(A, m2)			221.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.6466			(33)
E-WM-30			56.1200	0.0000	0.0000	45.0000	2525.4000	(32)
GF Timber			80.7200			9.0000	726.4800	(32c)
1F Timber			74.5300			9.0000	670.7700	(32c)
TF Timber			26.4100			9.0000	237.6900	(32c)
Internal Floor			41.8200			18.0000	752.7600	(32d)
Internal Floor			24.7800			18.0000	446.0400	(32d)
Internal Ceiling FF			41.8200			9.0000	376.3800	(32e)
Internal Ceiling TF			24.7800			18.0000	446.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14816.2590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.6561	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.9654	(36)
Total fabric heat loss	(33) + (36) =	69.6120	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.9759	51.4567	51.4567	50.7255	50.7255	49.8392	50.0513	49.6335	49.8392	50.2697	50.2697	50.9629	(38)
Heat transfer coeff	121.5879	121.0688	121.0688	120.3376	120.3376	119.4513	119.6633	119.2455	119.4513	119.8817	119.8817	120.5750	(39)
Average = Sum(39)m / 12 =												120.2125	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1215	1.1167	1.1167	1.1099	1.1099	1.1017	1.1037	1.0998	1.1017	1.1057	1.1057	1.1121	(40)
HLP (average)												1.1088	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8050	(42)
Average daily hot water use (litres/day)												100.8188	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.9007	106.8679	102.8352	98.8024	94.7697	90.7369	90.7369	94.7697	98.8024	102.8352	106.8679	110.9007	(44)
Energy conte	164.4625	143.8400	148.4299	129.4048	124.1670	107.1467	99.2872	113.9335	115.2942	134.3643	146.6691	159.2731	(45)
Energy content (annual)										Total = Sum(45)m =		1586.2723	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.6694	21.5760	22.2645	19.4107	18.6251	16.0720	14.8931	17.0900	17.2941	20.1546	22.0004	23.8910	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7103	13.2726	14.6622	14.1419	14.5699	14.0500	14.4872	14.5408	14.1000	14.6200	14.1983	14.6947	(61)
Total heat required for water heating calculated for each month													
	179.1728	157.1126	163.0921	143.5467	138.7369	121.1967	113.7743	128.4743	129.3942	148.9843	160.8674	173.9679	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2075	(H8)
Utilisation factor												0.5632	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.8188	(H14)
Volume ratio Veff/V												0.7439	(H15)
Solar storage volume factor												0.9408	(H16)
Solar input												-892.3350	(H17)
Solar input	-27.4656	-41.2808	-69.5221	-96.1008	-115.7376	-121.8088	-118.8840	-106.1641	-82.8615	-56.3691	-33.3852	-22.7554	(63)
										Solar input (sum of months) = Sum(63)m =		-892.3350	(63)
Output from w/h													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
										Total per year (kWh/year) = Sum(64)m =		871.7070	(64)
Heat gains from water heating, kWh/month													
	58.3614	51.1449	53.0185	46.5626	44.9280	39.1388	36.6348	41.5181	41.8603	48.3311	52.3171	56.6320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	168.3001	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.3326	58.9160	47.9137	36.2738	27.1151	22.8917	24.7353	32.1518	43.1541	54.7941	63.9528	68.1762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.8898	406.0601	395.5509	373.1782	344.9366	318.3934	300.6610	296.4906	306.9998	329.3726	357.6142	384.1573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	54.6350	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	-112.2001	(71)
Water heating gains (Table 5)													
	78.4427	76.1085	71.2614	64.6702	60.3871	54.3594	49.2403	55.8039	58.1393	64.9612	72.6626	76.1183	(72)
Total internal gains													
	660.4001	654.8197	628.4612	587.8572	546.1738	509.3796	488.3716	498.1814	522.0283	562.8629	607.9646	642.1868	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.1200	22.3313	0.4600	0.0000	0.7700	32.5882	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	6.6700	22.3313	0.4600	0.0000	0.7700	52.7580	(80)

Solar gains	129.9515	215.7388	326.2238	461.7425	533.8867	578.4784	547.2567	491.9475	400.4069	265.5906	163.1403	107.7078	(83)
Total gains	790.3516	870.5585	954.6849	1049.5998	1080.0605	1087.8579	1035.6283	990.1289	922.4352	828.4535	771.1049	749.8947	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8490	33.9941	33.9941	34.2007	34.2007	34.4545	34.3934	34.5139	34.4545	34.3307	34.3307	34.1333	
alpha	3.2566	3.2663	3.2663	3.2800	3.2800	3.2970	3.2929	3.3009	3.2970	3.2887	3.2887	3.2756	
util living area													
	0.9672	0.9539	0.9215	0.8491	0.7205	0.5119	0.3503	0.3750	0.6483	0.8686	0.9475	0.9713	(86)
MIT	19.4090	19.5906	19.9548	20.3929	20.7480	20.9447	20.9888	20.9860	20.8702	20.4431	19.8681	19.3776	(87)
Th 2	19.9834	19.9872	19.9872	19.9927	19.9927	19.9994	19.9978	20.0010	19.9994	19.9962	19.9962	19.9910	(88)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

util rest of house

	0.9609	0.9452	0.9062	0.8189	0.6635	0.4223	0.2407	0.2626	0.5652	0.8353	0.9358	0.9658 (89)
MIT 2	17.8897	18.1527	18.6720	19.2826	19.7430	19.9627	19.9942	19.9961	19.8952	19.3662	18.5613	17.8497 (90)
Living area fraction										fLA = Living area / (4) =		0.1372 (91)
MIT	18.0982	18.3500	18.8481	19.4350	19.8809	20.0975	20.1307	20.1320	20.0290	19.5140	18.7407	18.0594 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9482	18.2000	18.6981	19.2850	19.7309	19.9475	19.9807	19.9820	19.8790	19.3640	18.5907	17.9094 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9244	0.8810	0.7936	0.6469	0.4174	0.2387	0.2604	0.5541	0.8093	0.9137	0.9494	(94)
Useful gains	745.4240	804.7175	841.1039	832.9668	698.6909	454.0786	247.2505	257.8534	511.1442	670.5015	704.5236	711.9820	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1562.1887	1525.4707	1367.8413	1129.3660	809.9799	471.5319	248.9856	260.1890	558.9167	930.7639	1269.6266	1544.4887	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	607.6729	484.3462	391.8926	213.4075	82.7990	0.0000	0.0000	0.0000	0.0000	193.6352	406.8742	619.3850	(98)
Space heating												3000.0126	(98)
Space heating per m2											(98) / (4) =	27.6703	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3314.9310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	607.6729	484.3462	391.8926	213.4075	82.7990	0.0000	0.0000	0.0000	0.0000	193.6352	406.8742	619.3850	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	671.4618	535.1892	433.0305	235.8093	91.4906	0.0000	0.0000	0.0000	0.0000	213.9616	449.5847	684.4033	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	151.7072	115.8318	93.5701	47.4459	22.9993	0.0000	0.0000	22.3102	46.5328	92.6152	127.4822	151.2124	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8421	89.8643	89.8651	89.9006	89.7846	87.3000	87.3000	87.3000	87.3000	89.4393	89.7154	89.8537	(217)
Fuel for water heating, kWh/month													
	168.8598	128.8964	104.1228	52.7760	25.6161	0.0000	0.0000	25.5558	53.3022	103.5509	142.0962	168.2874	(219)
Water heating fuel used												973.0634	(219)
Annual totals kWh/year													
Space heating fuel - main system												3314.9310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												468.5817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3057.4165	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3314.9310	3.9200	129.9453	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.0634	3.9200	38.1441	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	468.5817	16.9600	79.4715	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			47.3834	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy	Emission factor	Emissions	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3314.9310	0.2160	716.0251	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0634	0.2160	210.1817	(264)
Space and water heating			926.2068	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.5817	0.5190	243.1939	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			287.5369	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3314.9310	1.2200	4044.2159	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.0634	1.2200	1187.1373	(264)
Space and water heating			5231.3532	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.5817	3.0700	1438.5460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1453.4791	(272)
Primary energy kWh/m2/year			13.4060	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	136.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	371.14	(P1)
Transmission heat loss coefficient	69.61	(37)
Summer heat loss coefficient	440.75	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.1200	117.5071	0.4600	0.0000	0.9000	200.4295
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	6.6700	117.5071	0.4600	0.0000	0.9000	324.4817
total:						639.6507

	Jun	Jul	Aug	
Solar gains	676	640	575	(P3/P4)
Internal gains	506	485	495	
Total summer gains	1183	1125	1070	(P5)
Summer gain/loss ratio	2.68	2.55	2.43	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.7)	1.04	1.04	1.04	
Threshold temperature	19.73	21.50	21.27	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-315	**Issued on Date**	19/10/2022
Assessment Reference	Plot 315	**Prop Type Ref**	2-As-SEMI
Property	Plot 315, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	16.99	**TER**	18.65
Environmental	87 B	**% DER<TER**	8.90		
CO_2 Emissions (t/year)	1.14	**DFEE**	46.50	**TFEE**	54.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.97		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 9.19 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 3.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	505.7151	614.9882	732.6616	853.6760	930.0844	917.1096	875.8067	808.4848	721.3041	599.3001	505.0269	473.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9844	0.9707	0.9402	0.8715	0.7560	0.6006	0.4615	0.5117	0.7365	0.9172	0.9742	0.9873	(86)
MIT	19.0157	19.2909	19.7222	20.2437	20.6455	20.8821	20.9625	20.9474	20.7611	20.2012	19.5101	18.9711	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9812	0.9647	0.9277	0.8445	0.7055	0.5203	0.3577	0.4057	0.6647	0.8938	0.9679	0.9846	(89)
MIT 2	17.2491	17.6486	18.2683	19.0051	19.5353	19.8213	19.8957	19.8876	19.6963	18.9665	17.9785	17.1909	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6916	18.0600	18.6325	19.3154	19.8134	20.0870	20.1630	20.1530	19.9630	19.2758	18.3622	17.6368	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5416	17.9100	18.4825	19.1654	19.6634	19.9370	20.0130	20.0030	19.8130	19.1258	18.2122	17.4868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9708	0.9494	0.9068	0.8227	0.6930	0.5221	0.3675	0.4146	0.6574	0.8721	0.9537	0.9757	(94)
Useful gains	490.9349	583.8576	664.3911	702.3471	644.5632	478.7803	321.8245	335.1603	474.1780	522.6556	481.6212	461.4981	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1326.2917	1299.3356	1193.3260	1008.6767	780.5059	516.9093	330.5586	348.1962	555.8770	835.6239	1094.7154	1315.9311	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	621.5054	480.8012	393.5276	220.5573	101.1413	0.0000	0.0000	0.0000	0.0000	232.8484	441.4278	635.6982	(98)
Space heating												3127.5073	(98)
Space heating per m2											(98) / (4) =	38.9381	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3455.8091	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	621.5054	480.8012	393.5276	220.5573	101.1413	0.0000	0.0000	0.0000	0.0000	232.8484	441.4278	635.6982	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	686.7464	531.2721	434.8371	243.7097	111.7584	0.0000	0.0000	0.0000	0.0000	257.2910	487.7655	702.4289	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8057	89.7351	89.5881	89.2677	88.6789	87.3000	87.3000	87.3000	87.3000	89.2806	89.6696	89.8335	(217)
Fuel for water heating, kWh/month													
	184.9686	162.3484	168.8652	149.2620	145.3021	129.0595	121.2740	136.7748	137.7020	154.8986	166.4037	179.5762	(219)
Water heating fuel used												1836.4354	(219)
Annual totals kWh/year													
Space heating fuel - main system												3455.8091	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5718.2906	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3455.8091	0.2160	746.4548	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4354	0.2160	396.6700	(264)
Space and water heating			1143.1248	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/year			1364.2427	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.9900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.4483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.4483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	500.0642	593.7955	692.8516	793.6555	855.9201	841.1749	803.6437	746.9976	673.9401	572.3114	495.0572	470.3029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9976	0.9942	0.9833	0.9447	0.8463	0.6737	0.5085	0.5643	0.8197	0.9705	0.9950	0.9982	(86)
MIT	19.6866	19.8647	20.1545	20.5211	20.8062	20.9543	20.9906	20.9848	20.8791	20.4879	20.0188	19.6596	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9968	0.9922	0.9773	0.9247	0.7941	0.5803	0.3908	0.4429	0.7413	0.9560	0.9929	0.9976	(89)
MIT 2	18.1612	18.4227	18.8441	19.3702	19.7406	19.9075	19.9335	19.9330	19.8383	19.3362	18.6580	18.1296	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9893	0.9719	0.9187	0.7986	0.6020	0.4204	0.4734	0.7552	0.9506	0.9903	0.9965	(94)
Useful gains	497.7192	587.4441	673.3627	729.0980	683.5541	506.3781	337.8680	353.6432	508.9453	544.0125	490.2700	468.6384	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1395.7710	1356.5581	1234.6029	1033.8842	796.2859	527.4303	340.7500	358.6984	570.7523	865.0223	1146.4932	1386.5926	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating												3300.1463	(98)
Space heating per m2											(98) / (4) =	41.0875	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3533.3472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.3646	553.3668	447.0692	234.9530	89.7992	0.0000	0.0000	0.0000	0.0000	255.7080	505.8679	731.2184	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8315	87.5811	87.0397	85.7848	83.5252	80.3000	80.3000	80.3000	80.3000	85.8781	87.3264	87.9183	(217)
Fuel for water heating, kWh/month													
	230.4413	202.9497	212.4694	191.2064	190.1295	174.1812	166.8789	186.0308	188.0853	200.2614	210.2295	224.7787	(219)
Water heating fuel used												2377.6422	(219)
Annual totals kWh/year													
Space heating fuel - main system												3533.3472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6337.0355	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3533.3472	0.2160	763.2030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.6422	0.2160	513.5707	(264)
Space and water heating			1276.7737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1497.8916	(272)
Emissions per m2 for space and water heating			15.8961	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8961 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	473.3592	583.4135	702.7091	825.9260	903.7654	892.8026	853.2064	783.6939	695.7320	571.4490	474.6018	441.4329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9871	0.9746	0.9460	0.8800	0.7670	0.6123	0.4720	0.5249	0.7508	0.9259	0.9782	0.9896	(86)
MIT	18.9640	19.2429	19.6814	20.2146	20.6286	20.8751	20.9600	20.9433	20.7460	20.1662	19.4630	18.9199	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9843	0.9692	0.9345	0.8543	0.7173	0.5317	0.3665	0.4172	0.6802	0.9043	0.9728	0.9873	(89)
MIT 2	18.0334	18.3112	18.7433	19.2633	19.6389	19.8469	19.9009	19.8953	19.7537	19.2318	18.5417	17.9976	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2665	18.5446	18.9783	19.5016	19.8868	20.1045	20.1662	20.1578	20.0023	19.4659	18.7725	18.2286	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2665	18.5446	18.9783	19.5016	19.8868	20.1045	20.1662	20.1578	20.0023	19.4659	18.7725	18.2286	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9607	0.9227	0.8433	0.7165	0.5467	0.3919	0.4424	0.6868	0.8936	0.9652	0.9826	(94)
Useful gains	463.3161	560.4902	648.4026	696.5111	647.5258	488.1072	334.3800	346.7099	477.8524	510.6548	458.0934	433.7725	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1398.9009	1362.7145	1242.7012	1041.7155	802.4003	533.1280	345.4046	363.1543	574.2930	868.9562	1149.9110	1389.4046	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	696.0751	539.0947	442.1582	248.5472	115.2266	0.0000	0.0000	0.0000	0.0000	266.5762	498.1087	710.9903	(98)
Space heating												3516.7770	(98)
Space heating per m2											(98) / (4) =	43.7846	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	910.4273	716.7194	734.4609	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8418	0.8945	0.8696	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	766.4069	641.1320	638.6928	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.6896	1087.5076	1007.8281	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	265.8836	332.1034	274.6366	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												872.6236	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.4709	83.0259	68.6592	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												218.1559	(107)
Space cooling per m2												2.7161	(108)
Energy for space heating												43.7846	(99)
Energy for space cooling												2.7161	(108)
Total												46.5007	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	455.5149	550.2930	651.5922	755.2169	819.5359	807.4240	771.5905	712.1334	637.6670	533.1410	452.6973	426.5244	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9984	0.9958	0.9869	0.9534	0.8628	0.6949	0.5278	0.5883	0.8426	0.9775	0.9966	0.9989	(86)
MIT	19.6357	19.8157	20.1103	20.4867	20.7862	20.9477	20.9890	20.9818	20.8615	20.4481	19.9708	19.6093	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9979	0.9944	0.9821	0.9359	0.8135	0.6011	0.4065	0.4635	0.7683	0.9659	0.9952	0.9985	(89)
MIT 2	18.6634	18.8450	19.1392	19.5142	19.7841	19.9135	19.9342	19.9340	19.8569	19.4858	19.0109	18.6459	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9929	0.9791	0.9327	0.8192	0.6233	0.4372	0.4951	0.7824	0.9631	0.9939	0.9979	(94)
Useful gains	454.2309	546.3609	637.9664	704.3706	671.3454	503.2474	337.3349	352.5620	498.8992	513.4908	449.9441	425.6452	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1431.4050	1386.2859	1255.0688	1043.4237	798.9274	527.7029	340.7552	358.6991	571.6601	874.8184	1170.8186	1422.8601	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0175	564.4296	459.1242	244.1182	94.9210	0.0000	0.0000	0.0000	0.0000	268.8277	519.0296	741.9278	(98)
Space heating												3619.3957	(98)
Space heating per m2											(98) / (4) =	45.0622	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8876	0.9393	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	790.0736	658.2243	658.7034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.8965	992.1124	924.1859	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9925	248.4128	197.5189	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												622.9242	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   44.2481   62.1032   49.3797    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        155.7311 (107)
Space cooling per m2                                                                                                   1.9389 (108)
Energy for space heating                                                                                              45.0622 (99)
Energy for space cooling                                                                                               1.9389 (108)
Total                                                                                                                 47.0011 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                54.1 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(80)
East	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(76)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)

Space heating 2190.3091 (98)
RHI space heating demand 2190 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833 (83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9647	0.9440	0.9031	0.8208	0.6966	0.5398	0.4070	0.4485	0.6604	0.8636	0.9459	0.9697	(86)
MIT	19.2919	19.5467	19.9356	20.3914	20.7256	20.9139	20.9741	20.9642	20.8294	20.3744	19.7539	19.2461	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6430	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6460	18.0117	18.5629	19.1957	19.6257	19.8486	19.9021	19.8978	19.7639	19.1928	18.3234	17.5873	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0583	18.3962	18.9067	19.4952	19.9012	20.1154	20.1706	20.1650	20.0308	19.4888	18.6817	18.0028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9083	18.2462	18.7567	19.3452	19.7512	19.9654	20.0206	20.0150	19.8808	19.3388	18.5317	17.8528	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9130	0.8618	0.7687	0.6348	0.4665	0.3222	0.3607	0.5833	0.8097	0.9138	0.9484	(94)
Useful gains	645.0927	723.6388	777.8252	778.0911	683.6470	492.0743	325.3593	340.6578	504.5980	610.8538	613.9852	615.3987	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

	1363.0212	1332.9153	1220.6415	1026.3498	789.1137	519.6630	331.3030	349.3476	562.4756	856.4989	1126.1903	1352.1836	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)

Space heating 2629.9570 (98)

Space heating per m2 (98) / (4) = 32.7435 (99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2906.0298	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	590.2086	452.4131	364.0390	197.5097	86.7041	0.0000	0.0000	0.0000	0.0000	201.9446	407.5002	605.7104	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7199	89.6377	89.4680	89.1051	88.4842	87.3000	87.3000	87.3000	87.3000	89.0933	89.5544	89.7520	(217)
Fuel for water heating, kWh/month													
	185.1457	162.5248	169.0920	149.5344	145.6219	129.0595	121.2740	136.7748	137.7020	155.2243	166.6178	179.7394	(219)
Water heating fuel used												1838.3106	(219)
Annual totals kWh/year													
Space heating fuel - main system												2906.0298	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5170.3865	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.0298	3.4800	101.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.3106	3.4800	63.9732	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Total energy cost			341.2985	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1438	(257)
SAP value		84.0435	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2906.0298	0.2160	627.7024	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.3106	0.2160	397.0751	(264)
Space and water heating			1024.7775	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1245.8955	(272)
CO2 emissions per m2			15.5100	(273)
EI value			86.6781	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8867 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8867 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(80)
East	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(76)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating												2190.3091	(98)
Space heating per m2											(98) / (4) =	27.2698	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.2310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	515.8749	397.6604	302.8182	147.0689	49.5429	0.0000	0.0000	0.0000	0.0000	143.9357	334.6058	528.7243	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6377	89.5541	89.3353	88.8703	88.1042	87.3000	87.3000	87.3000	87.3000	88.8234	89.4181	89.6713	(217)
Fuel for water heating, kWh/month													
	185.3153	162.6766	169.3432	149.9294	146.2500	129.0595	121.2740	136.7748	137.7020	155.6959	166.8719	179.9012	(219)
Water heating fuel used												1840.7938	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.2310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												4687.0709	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.2310	3.9200	94.8731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.7938	3.9200	72.1591	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Total energy cost			327.2896	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2420.2310	0.2160	522.7699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7938	0.2160	397.6115	(264)
Space and water heating			920.3814	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1141.4993	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2420.2310	1.2200	2952.6818	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7938	1.2200	2245.7684	(264)
Space and water heating			5198.4502	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Primary energy kWh/year			6506.4118	(272)
Primary energy kWh/m2/year			81.0061	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (15.9%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (98.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 89
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£72	£81	-£8
Mains gas	£255	£217	£38
Space heating	£196	£196	£0
Water heating	£72	£43	£29
Lighting	£60	£60	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£327	-£11	£339
Total cost of uses	£328	-£10	£338
Delivered energy	58 kWh/m²	24 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	81 kWh/m²	-1 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2416 (H8)
Utilisation factor	0.5531 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-844.3736 (H17)

Solar input

	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899 (63)

Solar input (sum of months) = Sum(63)m = -844.3736 (63)

Output from w/h

	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297 (64)

Total per year (kWh/year) = Sum(64)m = 794.2995 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(80)
East	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(76)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833 (83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area	0.9647	0.9440	0.9031	0.8208	0.6966	0.5398	0.4070	0.4485	0.6604	0.8636	0.9459	0.9697	(86)
MIT	19.2919	19.5467	19.9356	20.3914	20.7256	20.9139	20.9741	20.9642	20.8294	20.3744	19.7539	19.2461	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house	0.9578	0.9335	0.8848	0.7878	0.6430	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6460	18.0117	18.5629	19.1957	19.6257	19.8486	19.9021	19.8978	19.7639	19.1928	18.3234	17.5873	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0583	18.3962	18.9067	19.4952	19.9012	20.1154	20.1706	20.1650	20.0308	19.4888	18.6817	18.0028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9083	18.2462	18.7567	19.3452	19.7512	19.9654	20.0206	20.0150	19.8808	19.3388	18.5317	17.8528	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9130	0.8618	0.7687	0.6348	0.4665	0.3222	0.3607	0.5833	0.8097	0.9138	0.9484	(94)
Useful gains	645.0927	723.6388	777.8252	778.0911	683.6470	492.0743	325.3593	340.6578	504.5980	610.8538	613.9852	615.3987	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1363.0212	1332.9153	1220.6415	1026.3498	789.1137	519.6630	331.3030	349.3476	562.4756	856.4989	1126.1903	1352.1836	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating												2629.9570	(98)
Space heating per m2											(98) / (4) =	32.7435	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2906.0298	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	590.2086	452.4131	364.0390	197.5097	86.7041	0.0000	0.0000	0.0000	0.0000	201.9446	407.5002	605.7104	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8101	89.8288	89.8456	89.8977	90.0115	87.3000	87.3000	87.3000	87.3000	89.4503	89.6920	89.8270	(217)
Fuel for water heating, kWh/month	157.6965	116.6940	90.9295	44.4755	15.1504	0.0000	0.0000	24.9065	50.0868	96.2121	133.9815	156.7789	(219)
Water heating fuel used												886.9117	(219)

Annual totals kWh/year		
Space heating fuel - main system	2906.0298	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394	-1727.2394	(233)
Total delivered energy for all uses	2541.7483	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.0298	3.4800	101.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9117	3.4800	30.8645	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			86.9620	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.2914	(257)
SAP value	95.9343	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2906.0298	0.2160	627.7024	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9117	0.2160	191.5729	(264)
Space and water heating			819.2754	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			169.9061	(272)
CO2 emissions per m2			2.1200	(273)
EI value			98.1833	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)	
Total heat required for water heating calculated for each month													
166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3113	(H8)
Utilisation factor												0.5336	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-860.2505	(H17)
Solar input -26.4781	-39.7965	-67.0223	-92.6454	-111.5762	-117.4291	-114.6094	-102.3469	-79.8821	-54.3423	-32.1848	-21.9373	(63)	
									Solar input (sum of months) = Sum(63)m =		-860.2505	(63)	
Output from w/h													
139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)	
									Total per year (kWh/year) = Sum(64)m =		785.4083	(64)	
Heat gains from water heating, kWh/month													
54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(80)
East	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(76)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating												2190.3091	(98)
Space heating per m2											(98) / (4) =	27.2698	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.2310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	515.8749	397.6604	302.8182	147.0689	49.5429	0.0000	0.0000	0.0000	0.0000	143.9357	334.6058	528.7243	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7427	89.7521	89.7266	89.7312	89.5866	87.3000	87.3000	87.3000	87.3000	89.2183	89.5847	89.7578	(217)
Fuel for water heating, kWh/month	155.5942	117.9773	93.9085	45.2433	19.2843	0.0000	0.0000	19.5389	46.1990	94.0973	130.6349	155.2872	(219)
Water heating fuel used												877.7648	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.2310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												1949.8823	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.2310	3.9200	94.8731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.7648	3.9200	34.4084	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-11.3586	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2420.2310	0.2160	522.7699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7648	0.2160	189.5972	(264)
Space and water heating			712.3671	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			12.6962	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2420.2310	1.2200	2952.6818	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7648	1.2200	1070.8731	(264)
Space and water heating			4023.5549	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-115.1536	(272)
Primary energy kWh/m2/year			-1.4337	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
East	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						738.4060

	Jun	Jul	Aug	
Solar gains	781	738	662	(P4)
Internal gains	430	412	420	
Total summer gains	1210	1150	1082	(P5)
Summer gain/loss ratio	3.64	3.46	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.61	22.33	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-316	**Issued on Date**	19/10/2022
Assessment Reference	Plot 316	**Prop Type Ref**	3S-As-SEMI
Property	Plot 316, 3 Bed, K, WC, B, Staggered		

SAP Rating	85 B	**DER**	15.50	**TER**	17.01
Environmental	87 B	**% DER<TER**	8.88		
CO_2 Emissions (t/year)	1.27	**DFEE**	43.76	**TFEE**	50.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.83		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 98 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.01 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.50 kgCO□/m²OK
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1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²/yrOK
-------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.25 (max. 0.30)        0.25 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.12 (max. 0.25)        0.12 (max. 0.70)          OK
Roof            0.16 (max. 0.20)        0.16 (max. 0.35)          OK
Openings        1.30 (max. 2.00)        1.30 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         5.01 (design value)
Maximum                                 10.0                                            OK
-------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
-------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control               OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                             OK
-------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                             OK
-------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                          OK
Based on:
Overshading:                            Average
Windows facing East:                    3.29 m², No overhang
Windows facing South:                   8.06 m², No overhang
Windows facing West:                    7.64 m², No overhang
Air change rate:                        4.00 ach
Blinds/curtains:                        None
-------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Floor U-value                           0.12 W/m²K




-------------------------------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3690	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6670	49.3598	49.0587	47.6446	47.3800	46.1483	46.1483	45.9202	46.6227	47.3800	47.9152	48.4748	(38)
Heat transfer coeff	119.1871	118.8800	118.5789	117.1647	116.9001	115.6685	115.6685	115.4404	116.1429	116.9001	117.4354	117.9950	(39)
Average = Sum(39)m / 12 =												117.1635	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2174	1.2143	1.2112	1.1968	1.1941	1.1815	1.1815	1.1792	1.1863	1.1941	1.1995	1.2053	(40)
HLP (average)												1.1968	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
											Total per year (kWh/year) = Sum(64)m =	1726.1309	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	419.4128	417.2026	402.0617	377.5251	352.4122	328.3539	312.8136	319.1674	331.8472	356.6095	385.0719	406.6105	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	628.9184	784.5339	925.4623	1049.4817	1118.1799	1092.1461	1047.8712	985.1544	907.6095	768.8734	638.0868	584.4689	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.0082	32.0909	32.1724	32.5607	32.6344	32.9819	32.9819	33.0470	32.8471	32.6344	32.4856	32.3316	
alpha	3.1339	3.1394	3.1448	3.1707	3.1756	3.1988	3.1988	3.2031	3.1898	3.1756	3.1657	3.1554	
util living area													
	0.9813	0.9632	0.9287	0.8600	0.7497	0.5996	0.4596	0.5019	0.7120	0.8994	0.9682	0.9850	(86)
MIT	19.0200	19.3285	19.7581	20.2530	20.6389	20.8756	20.9603	20.9468	20.7744	20.2392	19.5300	18.9651	(87)
Th 2	19.9061	19.9086	19.9110	19.9226	19.9247	19.9348	19.9348	19.9367	19.9309	19.9247	19.9204	19.9158	(88)
util rest of house													
	0.9776	0.9561	0.9148	0.8324	0.7003	0.5215	0.3585	0.3996	0.6409	0.8732	0.9609	0.9819	(89)
MIT 2	17.2765	17.7228	18.3379	19.0351	19.5456	19.8334	19.9132	19.9056	19.7274	19.0350	18.0264	17.2027	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	17.6126	18.0323	18.6116	19.2699	19.7564	20.0343	20.1151	20.1063	19.9292	19.2671	18.3163	17.5424	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4626	17.8823	18.4616	19.1199	19.6064	19.8843	19.9651	19.9563	19.7792	19.1171	18.1663	17.3924	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9650	0.9374	0.8906	0.8078	0.6839	0.5175	0.3615	0.4016	0.6295	0.8482	0.9435	0.9711	(94)
Useful gains	606.9364	735.4433	824.2366	847.7240	764.6677	565.1617	378.7695	395.6541	571.2991	652.1303	602.0553	567.5883	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1568.8105	1543.3360	1418.3983	1197.4090	924.2537	611.2269	389.2309	410.5356	659.5956	995.6480	1299.5705	1556.6374	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	715.6343	542.9039	442.0563	251.7733	118.7319	0.0000	0.0000	0.0000	0.0000	255.5771	502.2109	735.8525	(98)
Space heating												3564.7403	(98)
Space heating per m2											(98) / (4) =	36.4121	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3938.9396	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	715.6343	542.9039	442.0563	251.7733	118.7319	0.0000	0.0000	0.0000	0.0000	255.5771	502.2109	735.8525	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	790.7562	599.8938	488.4600	278.2025	131.1955	0.0000	0.0000	0.0000	0.0000	282.4057	554.9292	813.0967	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8504	89.7721	89.6266	89.3250	88.7617	87.3000	87.3000	87.3000	87.3000	89.3085	89.7134	89.8795	(217)
Fuel for water heating, kWh/month													
	195.7023	171.7649	178.6117	157.7567	153.4599	136.3341	128.0150	144.5119	145.5334	163.7704	175.9988	189.9649	(219)
Water heating fuel used												1941.4241	(219)
Annual totals kWh/year													
Space heating fuel - main system												3938.9396	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	402.3561	(232)
Total delivered energy for all uses	6357.7198	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3938.9396	0.2160	850.8109	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1941.4241	0.2160	419.3476	(264)
Space and water heating			1270.1585	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Total CO2, kg/year			1517.9064	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.5000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.5000	ZC1
Total Floor Area	TFA	97.9000	
Assumed number of occupants	N	2.7192	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3070	ZC2
CO2 emissions from cooking, equation (L16)		1.8821	ZC3
Total CO2 emissions		32.6892	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.6892	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4347	0.4261	0.4176	0.3750	0.3665	0.3239	0.3239	0.3153	0.3409	0.3665	0.3835	0.4006	(22b)
Effective ac	0.5945	0.5908	0.5872	0.5703	0.5672	0.5524	0.5524	0.5497	0.5581	0.5672	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			18.9900	1.3258	25.1761			(27)
GF B&B J150 P/A=0.40			48.9500	0.1300	6.3635			(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.1800	15.2298			(29a)
Plane Ceiling	48.9500		48.9500	0.1300	6.3635			(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.2629			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4967	(36)
Total fabric heat loss					(33) + (36) =		66.7596	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6456	49.3392	49.0390	47.6286	47.3648	46.1364	46.1364	45.9089	46.6096	47.3648	47.8986	48.4566	(38)
Heat transfer coeff	116.4052	116.0989	115.7986	114.3883	114.1244	112.8960	112.8960	112.6686	113.3692	114.1244	114.6582	115.2163	(39)
Average = Sum(39)m / 12 =												114.3870	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1890	1.1859	1.1828	1.1684	1.1657	1.1532	1.1532	1.1509	1.1580	1.1657	1.1712	1.1769	(40)
HLP (average)												1.1684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7192	(42)
Average daily hot water use (litres/day)												98.7814	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)
Energy content (annual)										Total = Sum(45)m =		1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.7398	47.3176	43.8427	45.3041	47.3176	47.7398	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	212.0979	186.9605	196.3893	174.5296	168.9754	148.8241	142.5848	158.9487	160.7041	182.6079	193.0202	207.0134	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.0979	186.9605	196.3893	174.5296	168.9754	148.8241	142.5848	158.9487	160.7041	182.6079	193.0202	207.0134	(64)
								Total per year (kWh/year) = Sum(64)m =				2132.6558	(64)
Heat gains from water heating, kWh/month													
	66.3184	58.3671	61.0953	54.0925	52.2806	45.8670	43.6719	48.9467	49.4956	56.5130	60.1107	64.6278	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	89.1377	86.8558	82.1174	75.1285	70.2696	63.7042	58.6987	65.7886	68.7439	75.9583	83.4871	86.8654	(72)
Total internal gains													
	431.5964	429.3914	414.2612	389.1964	363.4209	338.7027	323.1724	330.1854	343.5325	368.8229	397.2683	418.7993	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.6300	0.7000	0.7700	19.7476	(76)
South	8.0600	46.7521	0.6300	0.7000	0.7700	115.1616	(78)
West	7.6400	19.6403	0.6300	0.7000	0.7700	45.8577	(80)

Solar gains	180.7669	316.9430	451.6037	579.7817	660.7244	659.0198	634.2269	574.6309	496.7827	355.7120	218.3079	153.4609	(83)
Total gains	612.3634	746.3344	865.8649	968.9781	1024.1453	997.7225	957.3993	904.8164	840.3152	724.5349	615.5762	572.2601	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.4047	58.5588	58.7107	59.4345	59.5719	60.2201	60.2201	60.3417	59.9688	59.5719	59.2946	59.0074	
alpha	4.8936	4.9039	4.9140	4.9623	4.9715	5.0147	5.0147	5.0228	4.9979	4.9715	4.9530	4.9338	
util living area													
	0.9976	0.9933	0.9809	0.9420	0.8470	0.6780	0.5094	0.5574	0.8021	0.9647	0.9945	0.9983	(86)
MIT	19.7302	19.9251	20.2088	20.5493	20.8146	20.9558	20.9913	20.9866	20.8963	20.5332	20.0620	19.6975	(87)
Th 2	19.9288	19.9313	19.9338	19.9453	19.9475	19.9576	19.9576	19.9595	19.9537	19.9475	19.9431	19.9385	(88)
util rest of house													
	0.9968	0.9911	0.9743	0.9214	0.7956	0.5858	0.3936	0.4391	0.7223	0.9480	0.9922	0.9977	(89)
MIT 2	18.2422	18.5278	18.9393	19.4263	19.7703	19.9290	19.9545	19.9542	19.8743	19.4152	18.7369	18.2014	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	18.5290	18.7971	19.1840	19.6428	19.9716	20.1269	20.1544	20.1532	20.0713	19.6307	18.9923	18.4898	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5290	18.7971	19.1840	19.6428	19.9716	20.1269	20.1544	20.1532	20.0713	19.6307	18.9923	18.4898	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9876	0.9680	0.9141	0.7969	0.6017	0.4160	0.4618	0.7324	0.9413	0.9892	0.9964	(94)
Useful gains	609.3914	737.0888	838.1673	885.7664	816.1256	600.3588	398.2823	417.8813	615.4694	682.0294	608.9445	570.2250	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1656.3348	1613.4369	1468.7879	1228.8455	943.9897	623.9702	401.2749	422.8680	676.9588	1030.6222	1363.5537	1646.4166	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	778.9259	588.9059	469.1818	247.0169	95.1309	0.0000	0.0000	0.0000	0.0000	259.3530	543.3186	800.6865	(98)
Space heating												3782.5195	(98)
Space heating per m2											(98) / (4) =	38.6366	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4049.8068	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	778.9259	588.9059	469.1818	247.0169	95.1309	0.0000	0.0000	0.0000	0.0000	259.3530	543.3186	800.6865	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	833.9678	630.5202	502.3359	264.4721	101.8532	0.0000	0.0000	0.0000	0.0000	277.6799	581.7116	857.2661	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.0979	186.9605	196.3893	174.5296	168.9754	148.8241	142.5848	158.9487	160.7041	182.6079	193.0202	207.0134	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0303	87.7407	87.1650	85.9254	83.6671	80.3000	80.3000	80.3000	80.3000	85.9341	87.5146	88.1230	(217)
Fuel for water heating, kWh/month													
	240.9373	213.0831	225.3075	203.1175	201.9617	185.3351	177.5652	197.9436	200.1296	212.4975	220.5578	234.9141	(219)
Water heating fuel used												2513.3499	(219)
Annual totals kWh/year													
Space heating fuel - main system												4049.8068	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Total delivered energy for all uses												7040.5128	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4049.8068	0.2160	874.7583	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2513.3499	0.2160	542.8836	(264)
Space and water heating			1417.6418	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Total CO2, kg/m2/year			1665.3897	(272)
Emissions per m2 for space and water heating			14.4805	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1330	(272b)
Emissions per m2 for pumps and fans			0.3976	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4805 * 1.00) + 2.1330 + 0.3976, rounded to 2 d.p.			17.0100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1185	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3690	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259	(36)
Total fabric heat loss	(33) + (36) =	69.5202	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6670	49.3598	49.0587	47.6446	47.3800	46.1483	46.1483	45.9202	46.6227	47.3800	47.9152	48.4748	(38)
Heat transfer coeff	119.1871	118.8800	118.5789	117.1647	116.9001	115.6685	115.6685	115.4404	116.1429	116.9001	117.4354	117.9950	(39)
Average = Sum(39)m / 12 =												117.1635	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2174	1.2143	1.2112	1.1968	1.1941	1.1815	1.1815	1.1792	1.1863	1.1941	1.1995	1.2053	(40)
HLP (average)												1.1968	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.2420	29.9483	30.9040	26.9428	25.8523	22.3085	20.6721	23.7216	24.0049	27.9754	30.5373	33.1616	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	46.0242	44.5659	41.5376	37.4206	34.7477	30.9841	27.7851	31.8839	33.3401	37.6013	42.4130	44.5720	(72)
Total internal gains													
	385.4830	384.1015	370.6814	348.4885	324.8989	302.9826	289.2588	293.2807	305.1287	327.4659	353.1941	373.5059	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	594.9886	751.4328	894.0820	1020.4451	1090.6667	1066.7748	1024.3164	959.2677	880.8910	739.7298	606.2091	551.3643	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.0082	32.0909	32.1724	32.5607	32.6344	32.9819	32.9819	33.0470	32.8471	32.6344	32.4856	32.3316	
alpha	3.1339	3.1394	3.1448	3.1707	3.1756	3.1988	3.1988	3.2031	3.1898	3.1756	3.1657	3.1554	
util living area													
	0.9840	0.9670	0.9342	0.8676	0.7593	0.6098	0.4687	0.5130	0.7242	0.9076	0.9722	0.9872	(86)
MIT	18.9743	19.2867	19.7231	20.2281	20.6241	20.8693	20.9580	20.9433	20.7623	20.2100	19.4888	18.9197	(87)
Th 2	19.9061	19.9086	19.9110	19.9226	19.9247	19.9348	19.9348	19.9367	19.9309	19.9247	19.9204	19.9158	(88)
util rest of house													
	0.9807	0.9606	0.9212	0.8410	0.7106	0.5314	0.3661	0.4093	0.6537	0.8830	0.9657	0.9846	(89)
MIT 2	18.0656	18.3755	18.8038	19.2944	19.6542	19.8617	19.9192	19.9139	19.7835	19.2908	18.5871	18.0185	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	18.2407	18.5511	18.9810	19.4744	19.8411	20.0559	20.1194	20.1123	19.9722	19.4680	18.7609	18.1922	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2407	18.5511	18.9810	19.4744	19.8411	20.0559	20.1194	20.1123	19.9722	19.4680	18.7609	18.1922	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9739	0.9501	0.9074	0.8282	0.7064	0.5409	0.3846	0.4274	0.6567	0.8702	0.9563	0.9789	(94)
Useful gains	579.4818	713.9026	811.2848	845.1009	770.4477	577.0444	393.9948	409.9766	578.5129	643.7158	579.7136	539.7083	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1661.5534	1622.8410	1479.9798	1238.9419	951.7002	631.0803	407.0834	428.5538	682.0117	1036.6654	1369.4065	1651.0120	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	805.0613	610.8066	497.5091	283.5655	134.8518	0.0000	0.0000	0.0000	0.0000	292.3545	568.5789	826.8099	(98)
Space heating												4019.5375	(98)
Space heating per m2											(98) / (4) =	41.0576	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1087.2834	855.9465	877.3467	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8371	0.8913	0.8708	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	910.1135	762.9266	763.9659	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1350.8299	1298.9742	1224.7928	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	317.3158	398.8194	342.8552	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1058.9904	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	79.3289	99.7049	85.7138	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												264.7476	(107)
Space cooling per m2												2.7043	(108)
Energy for space heating												41.0576	(99)
Energy for space cooling												2.7043	(108)
Total												43.7619	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3685	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3409	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4347	0.4261	0.4176	0.3750	0.3665	0.3239	0.3239	0.3153	0.3409	0.3665	0.3835	0.4006	(22b)
Effective ac	0.5945	0.5908	0.5872	0.5703	0.5672	0.5524	0.5524	0.5497	0.5581	0.5672	0.5735	0.5802	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			18.9900	1.3258	25.1761			(27)
GF B&B J150 P/A=0.40			48.9500	0.1300	6.3635			(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.1800	15.2298			(29a)
Plane Ceiling	48.9500		48.9500	0.1300	6.3635			(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.2629			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4967	(36)
Total fabric heat loss					(33) + (36) =		66.7596	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6456	49.3392	49.0390	47.6286	47.3648	46.1364	46.1364	45.9089	46.6096	47.3648	47.8986	48.4566	(38)
Heat transfer coeff	116.4052	116.0989	115.7986	114.3883	114.1244	112.8960	112.8960	112.6686	113.3692	114.1244	114.6582	115.2163	(39)
Average = Sum(39)m / 12 =												114.3870	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1890	1.1859	1.1828	1.1684	1.1657	1.1532	1.1532	1.1509	1.1580	1.1657	1.1712	1.1769	(40)
HLP (average)												1.1684	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7192	(42)
Average daily hot water use (litres/day)												98.7814	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)
Energy content (annual)										Total = Sum(45)m =		1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.2420	29.9483	30.9040	26.9428	25.8523	22.3085	20.6721	23.7216	24.0049	27.9754	30.5373	33.1616	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	135.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7831	20.2357	16.4568	12.4589	9.3131	7.8625	8.4958	11.0431	14.8220	18.8200	21.9657	23.4163	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.8874	255.5116	248.8988	234.8208	217.0499	200.3477	189.1897	186.5655	193.1783	207.2563	225.0272	241.7294	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	36.5961	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	46.0242	44.5659	41.5376	37.4206	34.7477	30.9841	27.7851	31.8839	33.3401	37.6013	42.4130	44.5720	(72)
Total internal gains													
	385.4830	384.1015	370.6814	348.4885	324.8989	302.9826	289.2588	293.2807	305.1287	327.4659	353.1941	373.5059	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.6300	0.7000	0.7700	19.7476	(76)
South	8.0600	46.7521	0.6300	0.7000	0.7700	115.1616	(78)
West	7.6400	19.6403	0.6300	0.7000	0.7700	45.8577	(80)

Solar gains	180.7669	316.9430	451.6037	579.7817	660.7244	659.0198	634.2269	574.6309	496.7827	355.7120	218.3079	153.4609	(83)
Total gains	566.2499	701.0445	822.2851	928.2702	985.6233	962.0024	923.4857	867.9116	801.9115	683.1779	571.5020	526.9668	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.4047	58.5588	58.7107	59.4345	59.5719	60.2201	60.2201	60.3417	59.9688	59.5719	59.2946	59.0074	
alpha	4.8936	4.9039	4.9140	4.9623	4.9715	5.0147	5.0147	5.0228	4.9979	4.9715	4.9530	4.9338	
util living area													
	0.9983	0.9949	0.9845	0.9500	0.8618	0.6969	0.5265	0.5783	0.8228	0.9717	0.9960	0.9988	(86)
MIT	19.6868	19.8833	20.1708	20.5198	20.7972	20.9500	20.9899	20.9843	20.8827	20.4997	20.0209	19.6546	(87)
Th 2	19.9288	19.9313	19.9338	19.9453	19.9475	19.9576	19.9576	19.9595	19.9537	19.9475	19.9431	19.9385	(88)
util rest of house													
	0.9977	0.9931	0.9790	0.9317	0.8128	0.6045	0.4077	0.4569	0.7459	0.9578	0.9943	0.9984	(89)
MIT 2	18.7340	18.9316	19.2180	19.5642	19.8135	19.9353	19.9552	19.9552	19.8910	19.5530	19.0790	18.7097	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	18.9177	19.1151	19.4016	19.7484	20.0031	20.1309	20.1546	20.1535	20.0822	19.7355	19.2605	18.8919	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9177	19.1151	19.4016	19.7484	20.0031	20.1309	20.1546	20.1535	20.0822	19.7355	19.2605	18.8919	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9913	0.9754	0.9275	0.8157	0.6209	0.4308	0.4804	0.7566	0.9542	0.9928	0.9978	(94)
Useful gains	564.5139	694.9502	802.0355	860.9633	804.0101	597.3133	397.8053	416.9688	606.7635	651.8713	567.4130	525.8193	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1701.5709	1650.3522	1493.9899	1240.9319	947.5849	624.4111	401.3020	422.9066	678.1926	1042.5814	1394.3040	1692.7413	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	845.9704	642.0301	514.8141	273.5774	106.8197	0.0000	0.0000	0.0000	0.0000	290.6883	595.3616	868.1899	(98)
Space heating												4137.4514	(98)
Space heating per m2											(98) / (4) =	42.2620	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1061.2228	835.4307	856.2811	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8883	0.9411	0.9233	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	942.7020	786.2305	790.5936	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1228.3687	1181.1201	1118.0130	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	205.6800	293.7979	243.6000	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												743.0779	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   51.4200   73.4495   60.9000    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        185.7695 (107)
Space cooling per m2                                                                                                   1.8975 (108)
Energy for space heating                                                                                              42.2620 (99)
Energy for space cooling                                                                                               1.8975 (108)
Total                                                                                                                 44.1596 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   50.8 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500	(1b)	x 2.5400	(2b) =	124.3330	(1b) - (3b)
First floor	48.9500	(1c)	x 2.6300	(2c) =	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3690	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3584	0.3414	0.3414	0.3158	0.3158	0.2816	0.2902	0.2731	0.2816	0.2987	0.2987	0.3243	(22b)
Effective ac	0.5642	0.5583	0.5583	0.5499	0.5499	0.5397	0.5421	0.5373	0.5397	0.5446	0.5446	0.5526	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13733.8630	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.2846	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.4259	(36)
Total fabric heat loss	(33) + (36) = 69.5202	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1215	46.6227	46.6227	45.9202	45.9202	45.0687	45.2724	44.8710	45.0687	45.4823	45.4823	46.1483	(38)
Heat transfer coeff	116.6416	116.1429	116.1429	115.4404	115.4404	114.5888	114.7926	114.3911	114.5888	115.0024	115.0024	115.6685	(39)
Average = Sum(39)m / 12 =												115.3202	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1914	1.1863	1.1863	1.1792	1.1792	1.1705	1.1725	1.1684	1.1705	1.1747	1.1747	1.1815	(40)
HLP (average)												1.1779	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m

	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851 (61)

Total heat required for water heating calculated for each month

	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395 (64)

Total per year (kWh/year) = Sum(64)m = 1726.1309 (64)
RHI water heating demand 1726 (64)
Heat gains from water heating, kWh/month

	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687 (71)

Water heating gains (Table 5)

	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766 (72)
Total internal gains	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	22.3313	0.4600	0.0000	0.7700	26.0231	(76)
South	8.0600	50.9848	0.4600	0.0000	0.7700	145.5541	(78)
West	4.3100	22.3313	0.4600	0.0000	0.7700	34.0910	(80)
West	3.3300	22.3313	0.4600	0.0000	0.7700	26.3395	(80)

Solar gains	232.0077	366.0594	515.7805	684.3362	762.2292	814.9564	775.2491	716.2702	615.5791	438.7545	287.0391	195.0719	(83)
Total gains	854.7822	984.0951	1109.7499	1240.8382	1280.1468	1298.4135	1238.6199	1188.5233	1109.4375	970.3060	860.5244	800.4981	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7067	32.8471	32.8471	33.0470	33.0470	33.2926	33.2335	33.3502	33.2926	33.1729	33.1729	32.9819	
alpha	3.1804	3.1898	3.1898	3.2031	3.2031	3.2195	3.2156	3.2233	3.2195	3.2115	3.2115	3.1988	
util living area	0.9522	0.9272	0.8751	0.7742	0.6268	0.4230	0.2836	0.3032	0.5469	0.8020	0.9202	0.9593	(86)
MIT	19.4888	19.7258	20.1152	20.5326	20.8236	20.9653	20.9933	20.9916	20.9155	20.5582	19.9741	19.4402	(87)
Th 2	19.9269	19.9309	19.9309	19.9367	19.9367	19.9437	19.9420	19.9453	19.9437	19.9403	19.9403	19.9348	(88)
util rest of house	0.9432	0.9140	0.8527	0.7353	0.5650	0.3404	0.1885	0.2055	0.4635	0.7581	0.9033	0.9515	(89)
MIT 2	17.9634	18.3017	18.8466	19.4113	19.7713	19.9224	19.9401	19.9427	19.8810	19.4627	18.6670	17.8996	(90)

Living area fraction fLA = Living area / (4) = 0.1927 (91)

MIT	18.2574	18.5762	19.0911	19.6274	19.9741	20.1234	20.1431	20.1449	20.0804	19.6738	18.9190	18.1966	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1074	18.4262	18.9411	19.4774	19.8241	19.9734	19.9931	19.9949	19.9304	19.5238	18.7690	18.0466	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9226	0.8902	0.8277	0.7164	0.5579	0.3428	0.1932	0.2101	0.4624	0.7381	0.8791	0.9324	(94)
Useful gains	788.5950	876.0785	918.5014	888.9639	714.2438	445.0556	239.2777	249.7573	513.0058	716.1731	756.5135	746.3448	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1517.2066	1489.6720	1340.4202	1105.6216	787.7771	455.3073	240.2714	251.0784	542.0471	911.2583	1238.4576	1497.5097	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	542.0871	412.3348	313.9076	155.9935	54.7087	0.0000	0.0000	0.0000	0.0000	145.1434	346.9998	558.8667	(98)

Space heating 2530.0416 (98)
RHI space heating demand 2530 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500	(1b)	x 2.5400	(2b) =	124.3330	(1b) - (3b)
First floor	48.9500	(1c)	x 2.6300	(2c) =	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3690	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6670	49.3598	49.0587	47.6446	47.3800	46.1483	46.1483	45.9202	46.6227	47.3800	47.9152	48.4748	(38)
Heat transfer coeff	119.1871	118.8800	118.5789	117.1647	116.9001	115.6685	115.6685	115.4404	116.1429	116.9001	117.4354	117.9950	(39)
Average = Sum(39)m / 12 =												117.1635	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2174	1.2143	1.2112	1.1968	1.1941	1.1815	1.1815	1.1792	1.1863	1.1941	1.1995	1.2053	(40)
HLP (average)												1.1968	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
									Total per year (kWh/year) = Sum(64)m =			1726.1309	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	832.2801	985.3671	1117.3700	1228.4586	1283.6854	1247.2493	1198.4284	1138.2401	1069.6207	943.8154	826.5003	783.2846	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.0082	32.0909	32.1724	32.5607	32.6344	32.9819	32.9819	33.0470	32.8471	32.6344	32.4856	32.3316	
alpha	3.1339	3.1394	3.1448	3.1707	3.1756	3.1988	3.1988	3.2031	3.1898	3.1756	3.1657	3.1554	
util living area													
	0.9611	0.9355	0.8915	0.8116	0.6940	0.5423	0.4084	0.4440	0.6426	0.8466	0.9392	0.9670	(86)
MIT	19.2835	19.5683	19.9555	20.3900	20.7152	20.9070	20.9717	20.9626	20.8342	20.3953	19.7596	19.2280	(87)
Th 2	19.9061	19.9086	19.9110	19.9226	19.9247	19.9348	19.9348	19.9367	19.9309	19.9247	19.9204	19.9158	(88)
util rest of house													
	0.9539	0.9241	0.8724	0.7789	0.6419	0.4670	0.3160	0.3500	0.5697	0.8122	0.9264	0.9608	(89)
MIT 2	17.6547	18.0620	18.6092	19.2119	19.6325	19.8610	19.9199	19.9155	19.7865	19.2371	18.3502	17.5813	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	17.9686	18.3524	18.8687	19.4390	19.8412	20.0626	20.1226	20.1173	19.9885	19.4604	18.6218	17.8987	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8186	18.2024	18.7187	19.2890	19.6912	19.9126	19.9726	19.9673	19.8385	19.3104	18.4718	17.7487	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9348	0.9006	0.8467	0.7567	0.6294	0.4653	0.3194	0.3528	0.5629	0.7885	0.9035	0.9434	(94)
Useful gains	777.9792	887.4325	946.0918	929.6097	808.0018	580.3637	382.7763	401.5438	602.0515	744.2373	746.7312	738.9405	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1611.2444	1581.3829	1448.8802	1217.2228	934.1671	614.4994	390.1024	411.8111	666.4805	1018.2423	1335.4560	1598.6829	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	619.9493	466.3347	374.0746	207.0814	93.8670	0.0000	0.0000	0.0000	0.0000	203.8597	423.8819	639.6484	(98)
Space heating												3028.6970	(98)
Space heating per m2											(98) / (4) =	30.9366	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3346.6265	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	619.9493	466.3347	374.0746	207.0814	93.8670	0.0000	0.0000	0.0000	0.0000	203.8597	423.8819	639.6484	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	685.0269	515.2869	413.3421	228.8192	103.7204	0.0000	0.0000	0.0000	0.0000	225.2594	468.3778	706.7938	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7729	89.6831	89.5166	89.1764	88.5778	87.3000	87.3000	87.3000	87.3000	89.1351	89.6086	89.8064	(217)
Fuel for water heating, kWh/month													
	195.8712	171.9354	178.8311	158.0197	153.7785	136.3341	128.0150	144.5119	145.5334	164.0889	176.2048	190.1195	(219)
Water heating fuel used												1943.2435	(219)
Annual totals kWh/year													
Space heating fuel - main system												3346.6265	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Total delivered energy for all uses												5767.2261	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3346.6265	3.4800	116.4626	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1943.2435	3.4800	67.6249	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	402.3561	13.1900	53.0708	(250)
Additional standing charges			120.0000	(251)
Total energy cost			367.0508	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0788	(257)
SAP value		84.9507	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3346.6265	0.2160	722.8713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1943.2435	0.2160	419.7406	(264)
Space and water heating			1142.6119	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Total kg/year			1390.3598	(272)
CO2 emissions per m2			14.2000	(273)
EI value			86.9623	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8871 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8871 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3690	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3584	0.3414	0.3414	0.3158	0.3158	0.2816	0.2902	0.2731	0.2816	0.2987	0.2987	0.3243	(22b)
Effective ac	0.5642	0.5583	0.5583	0.5499	0.5499	0.5397	0.5421	0.5373	0.5397	0.5446	0.5446	0.5526	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1215	46.6227	46.6227	45.9202	45.9202	45.0687	45.2724	44.8710	45.0687	45.4823	45.4823	46.1483	(38)
Heat transfer coeff	116.6416	116.1429	116.1429	115.4404	115.4404	114.5888	114.7926	114.3911	114.5888	115.0024	115.0024	115.6685	(39)
Average = Sum(39)m / 12 =												115.3202	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1914	1.1863	1.1863	1.1792	1.1792	1.1705	1.1725	1.1684	1.1705	1.1747	1.1747	1.1815	(40)
HLP (average)												1.1779	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
										Total per year (kWh/year) = Sum(64)m =		1726.1309	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	22.3313	0.4600	0.0000	0.7700	26.0231	(76)
South	8.0600	50.9848	0.4600	0.0000	0.7700	145.5541	(78)
West	4.3100	22.3313	0.4600	0.0000	0.7700	34.0910	(80)
West	3.3300	22.3313	0.4600	0.0000	0.7700	26.3395	(80)

Solar gains	232.0077	366.0594	515.7805	684.3362	762.2292	814.9564	775.2491	716.2702	615.5791	438.7545	287.0391	195.0719	(83)
Total gains	854.7822	984.0951	1109.7499	1240.8382	1280.1468	1298.4135	1238.6199	1188.5233	1109.4375	970.3060	860.5244	800.4981	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7067	32.8471	32.8471	33.0470	33.0470	33.2926	33.2335	33.3502	33.2926	33.1729	33.1729	32.9819	
alpha	3.1804	3.1898	3.1898	3.2031	3.2031	3.2195	3.2156	3.2233	3.2195	3.2115	3.2115	3.1988	
util living area													
	0.9522	0.9272	0.8751	0.7742	0.6268	0.4230	0.2836	0.3032	0.5469	0.8020	0.9202	0.9593	(86)
MIT	19.4888	19.7258	20.1152	20.5326	20.8236	20.9653	20.9933	20.9916	20.9155	20.5582	19.9741	19.4402	(87)
Th 2	19.9269	19.9309	19.9309	19.9367	19.9367	19.9437	19.9420	19.9453	19.9437	19.9403	19.9403	19.9348	(88)
util rest of house													
	0.9432	0.9140	0.8527	0.7353	0.5650	0.3404	0.1885	0.2055	0.4635	0.7581	0.9033	0.9515	(89)
MIT 2	17.9634	18.3017	18.8466	19.4113	19.7713	19.9224	19.9401	19.9427	19.8810	19.4627	18.6670	17.8996	(90)
Living area fraction									fLA = Living area / (4) =			0.1927	(91)
MIT	18.2574	18.5762	19.0911	19.6274	19.9741	20.1234	20.1431	20.1449	20.0804	19.6738	18.9190	18.1966	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1074	18.4262	18.9411	19.4774	19.8241	19.9734	19.9931	19.9949	19.9304	19.5238	18.7690	18.0466	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9226	0.8902	0.8277	0.7164	0.5579	0.3428	0.1932	0.2101	0.4624	0.7381	0.8791	0.9324	(94)
Useful gains	788.5950	876.0785	918.5014	888.9639	714.2438	445.0556	239.2777	249.7573	513.0058	716.1731	756.5135	746.3448	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1517.2066	1489.6720	1340.4202	1105.6216	787.7771	455.3073	240.2714	251.0784	542.0471	911.2583	1238.4576	1497.5097	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	542.0871	412.3348	313.9076	155.9935	54.7087	0.0000	0.0000	0.0000	0.0000	145.1434	346.9998	558.8667	(98)
Space heating												2530.0416	(98)
Space heating per m2											(98) / (4) =	25.8431	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2795.6260	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.0871	412.3348	313.9076	155.9935	54.7087	0.0000	0.0000	0.0000	0.0000	145.1434	346.9998	558.8667	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	598.9912	455.6186	346.8593	172.3686	60.4516	0.0000	0.0000	0.0000	0.0000	160.3794	383.4252	617.5322	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6947	89.6060	89.3933	88.9525	88.1936	87.3000	87.3000	87.3000	87.3000	88.8651	89.4743	89.7303	(217)
Fuel for water heating, kWh/month													
	196.0419	172.0833	179.0778	158.4174	154.4484	136.3341	128.0150	144.5119	145.5334	164.5875	176.4691	190.2808	(219)
Water heating fuel used												1945.8006	(219)
Annual totals kWh/year													
Space heating fuel - main system												2795.6260	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Total delivered energy for all uses												5218.7828	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2795.6260	3.9200	109.5885	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1945.8006	3.9200	76.2754	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	402.3561	16.9600	68.2396	(250)
Additional standing charges			88.0000	(251)
Total energy cost			354.8235	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2795.6260	0.2160	603.8552	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1945.8006	0.2160	420.2929	(264)
Space and water heating			1024.1482	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Total kg/year			1271.8960	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2795.6260	1.2200	3410.6638	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1945.8006	1.2200	2373.8767	(264)
Space and water heating			5784.5405	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	402.3561	3.0700	1235.2333	(268)
Primary energy kWh/year			7250.0238	(272)
Primary energy kWh/m2/year			74.0554	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 85
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-189 kg (14.9%)
U Solar photovoltaic panels	+ 9.3	-£ 309	-947 kg (87.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.93 kg/m²	B 86	B 89
Solar photovoltaic panels	£309	9.67 kg/m²	A 95	A 97
Total Savings	£340	11.60 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£81	£89	-£8
Mains gas	£274	£235	£39
Space heating	£210	£210	£0
Water heating	£76	£46	£31
Lighting	£68	£68	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£355	£15	£340
Total cost of uses	£354	£15	£340
Delivered energy	53 kWh/m²	25 kWh/m²	28 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.1 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	1 kg/m²	12 kg/m²
Primary energy	74 kWh/m²	6 kWh/m²	68 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500	(1b)	x 2.5400	(2b) =	124.3330	(1b) - (3b)
First floor	48.9500	(1c)	x 2.6300	(2c) =	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1185	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3690	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.6670	49.3598	49.0587	47.6446	47.3800	46.1483	46.1483	45.9202	46.6227	47.3800	47.9152	48.4748	(38)
Heat transfer coeff	119.1871	118.8800	118.5789	117.1647	116.9001	115.6685	115.6685	115.4404	116.1429	116.9001	117.4354	117.9950	(39)
Average = Sum(39)m / 12 =												117.1635	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2174	1.2143	1.2112	1.1968	1.1941	1.1815	1.1815	1.1792	1.1863	1.1941	1.1995	1.2053	(40)
HLP (average)												1.1968	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7192 (42)
Average daily hot water use (litres/day)	98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1554.2159 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)
Total heat required for water heating calculated for each month													
	175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1669	(H8)
Utilisation factor												0.5756	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.7814	(H14)
Volume ratio Veff/V												0.7593	(H15)
Solar storage volume factor												0.9449	(H16)
Solar input												-867.2757	(H17)
Solar input	-25.1493	-41.9669	-71.4744	-95.7898	-118.3402	-116.3473	-114.8097	-100.3098	-78.5627	-53.6491	-29.8307	-21.0456	(63)
										Solar input (sum of months) = Sum(63)m =		-867.2757	(63)
Output from w/h													
	150.6900	112.2301	88.6092	45.1264	17.8733	2.6724	0.0000	25.8491	48.4879	92.6117	128.0639	149.6939	(64)
										Total per year (kWh/year) = Sum(64)m =		861.9079	(64)
Heat gains from water heating, kWh/month													
	57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	19.6403	0.4600	0.0000	0.7700	22.8872	(76)
South	8.0600	46.7521	0.4600	0.0000	0.7700	133.4702	(78)
West	4.3100	19.6403	0.4600	0.0000	0.7700	29.9829	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	209.5057	367.3313	523.4006	671.9566	765.7677	763.7922	735.0576	665.9870	575.7623	412.2639	253.0150	177.8584	(83)
Total gains	832.2801	985.3671	1117.3700	1228.4586	1283.6854	1247.2493	1198.4284	1138.2401	1069.6207	943.8154	826.5003	783.2846	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.0082	32.0909	32.1724	32.5607	32.6344	32.9819	32.9819	33.0470	32.8471	32.6344	32.4856	32.3316	
alpha	3.1339	3.1394	3.1448	3.1707	3.1756	3.1988	3.1988	3.2031	3.1898	3.1756	3.1657	3.1554	
util living area													
	0.9611	0.9355	0.8915	0.8116	0.6940	0.5423	0.4084	0.4440	0.6426	0.8466	0.9392	0.9670	(86)
MIT	19.2835	19.5683	19.9555	20.3900	20.7152	20.9070	20.9717	20.9626	20.8342	20.3953	19.7596	19.2280	(87)
Th 2	19.9061	19.9086	19.9110	19.9226	19.9247	19.9348	19.9348	19.9367	19.9309	19.9247	19.9204	19.9158	(88)
util rest of house													
	0.9539	0.9241	0.8724	0.7789	0.6419	0.4670	0.3160	0.3500	0.5697	0.8122	0.9264	0.9608	(89)
MIT 2	17.6547	18.0620	18.6092	19.2119	19.6325	19.8610	19.9199	19.9155	19.7865	19.2371	18.3502	17.5813	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	17.9686	18.3524	18.8687	19.4390	19.8412	20.0626	20.1226	20.1173	19.9885	19.4604	18.6218	17.8987	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8186	18.2024	18.7187	19.2890	19.6912	19.9126	19.9726	19.9673	19.8385	19.3104	18.4718	17.7487	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9348	0.9006	0.8467	0.7567	0.6294	0.4653	0.3194	0.3528	0.5629	0.7885	0.9035	0.9434	(94)
Useful gains	777.9792	887.4325	946.0918	929.6097	808.0018	580.3637	382.7763	401.5438	602.0515	744.2373	746.7312	738.9405	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1611.2444	1581.3829	1448.8802	1217.2228	934.1671	614.4994	390.1024	411.8111	666.4805	1018.2423	1335.4560	1598.6829	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	619.9493	466.3347	374.0746	207.0814	93.8670	0.0000	0.0000	0.0000	0.0000	203.8597	423.8819	639.6484	(98)
Space heating												3028.6970	(98)
Space heating per m2											(98) / (4) =	30.9366	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3346.6265	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	619.9493	466.3347	374.0746	207.0814	93.8670	0.0000	0.0000	0.0000	0.0000	203.8597	423.8819	639.6484	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	685.0269	515.2869	413.3421	228.8192	103.7204	0.0000	0.0000	0.0000	0.0000	225.2594	468.3778	706.7938	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	150.6900	112.2301	88.6092	45.1264	17.8733	2.6724	0.0000	25.8491	48.4879	92.6117	128.0639	149.6939	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8560	89.8611	89.8691	89.9103	89.9725	87.3000	87.3000	87.3000	87.3000	89.4755	89.7368	89.8752	(217)
Fuel for water heating, kWh/month	167.7017	124.8930	98.5980	50.1905	19.8653	3.0612	0.0000	29.6095	55.5417	103.5051	142.7106	166.5574	(219)
Water heating fuel used												962.2340	(219)
Annual totals kWh/year													
Space heating fuel - main system												3346.6265	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3108.9773	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3346.6265	3.4800	116.4626	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.2340	3.4800	33.4857	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	402.3561	13.1900	53.0708	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			111.6837	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3283	(257)
SAP value	95.4209	
SAP rating (Section 12)	95	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3346.6265	0.2160	722.8713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.2340	0.2160	207.8425	(264)
Space and water heating			930.7139	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			307.9745	(272)
CO2 emissions per m2			3.1500	(273)
EI value			97.1121	
EI rating			97	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9500 (1b)	x	2.5400 (2b)	=	124.3330	(1b) - (3b)
First floor	48.9500 (1c)	x	2.6300 (2c)	=	128.7385	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.0715	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1185	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3690	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3414	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3584	0.3414	0.3414	0.3158	0.3158	0.2816	0.2902	0.2731	0.2816	0.2987	0.2987	0.3243	(22b)
Effective ac	0.5642	0.5583	0.5583	0.5499	0.5499	0.5397	0.5421	0.5373	0.5397	0.5446	0.5446	0.5526	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			15.6600	1.2357	19.3517			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			48.9500	0.1200	5.8740	75.0000	3671.2500	(28a)
EW Brick AAC015	105.7300	21.1200	84.6100	0.2500	21.1525	52.3000	4425.1030	(29a)
Plane Ceiling	48.9500		48.9500	0.1600	7.8320	9.0000	440.5500	(30)
Total net area of external elements Aum(A, m2)			203.6300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0942			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			48.9500			18.0000	881.1000	(32d)
Internal Ceiling			48.9500			9.0000	440.5500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13733.8630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.2846 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4259 (36)
Total fabric heat loss	(33) + (36) =	69.5202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1215	46.6227	46.6227	45.9202	45.9202	45.0687	45.2724	44.8710	45.0687	45.4823	45.4823	46.1483	(38)
Heat transfer coeff	116.6416	116.1429	116.1429	115.4404	115.4404	114.5888	114.7926	114.3911	114.5888	115.0024	115.0024	115.6685	(39)
Average = Sum(39)m / 12 =												115.3202	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1914	1.1863	1.1863	1.1792	1.1792	1.1705	1.1725	1.1684	1.1705	1.1747	1.1747	1.1815	(40)
HLP (average)												1.1779	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7192 (42)
Average daily hot water use (litres/day)		98.7814 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6595	104.7083	100.7570	96.8058	92.8545	88.9033	88.9033	92.8545	96.8058	100.7570	104.7083	108.6595	(44)
Energy conte	161.1389	140.9332	145.4304	126.7897	121.6578	104.9814	97.2807	111.6310	112.9643	131.6490	143.7051	156.0545	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1554.2159	(45)
Distribution loss (46)m = 0.15 x (45)m													
24.1708	21.1400	21.8146	19.0185	18.2487	15.7472	14.5921	16.7447	16.9446	19.7473	21.5558	23.4082	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.7003	13.2639	14.6532	14.1265	14.5558	14.0383	14.4764	14.5279	14.0864	14.6119	14.1894	14.6851	(61)	
Total heat required for water heating calculated for each month													
175.8393	154.1970	160.0836	140.9163	136.2136	119.0197	111.7571	126.1589	127.0506	146.2608	157.8945	170.7395	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2324	(H8)
Utilisation factor												0.5558	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.7814	(H14)
Volume ratio Veff/V												0.7593	(H15)
Solar storage volume factor												0.9449	(H16)
Solar input												-884.4747	(H17)
Solar input -27.2237	-40.9172	-68.9097	-95.2543	-114.7181	-120.7359	-117.8368	-105.2289	-82.1316	-55.8726	-33.0911	-22.5550	(63)	
									Solar input (sum of months) = Sum(63)m =		-884.4747	(63)	
Output from w/h													
148.6156	113.2799	91.1739	45.6620	21.4954	0.0000	0.0000	20.9300	44.9191	90.3882	124.8034	148.1845	(64)	
									Total per year (kWh/year) = Sum(64)m =		849.4521	(64)	
Heat gains from water heating, kWh/month													
57.2538	50.1762	52.0189	45.6892	44.0902	38.4159	35.9649	40.7493	41.0822	47.4262	51.3293	55.5594	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	163.1530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.9577	50.5893	41.1420	31.1471	23.2828	19.6564	21.2394	27.6078	37.0551	47.0499	54.9142	58.5407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.4439	381.3606	371.4907	350.4788	323.9550	299.0264	282.3726	278.4559	288.3259	309.3378	335.8615	360.7901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	54.0345	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	-108.7687	(71)
Water heating gains (Table 5)													
	76.9540	74.6670	69.9179	63.4572	59.2610	53.3554	48.3400	54.7705	57.0586	63.7449	71.2907	74.6766	(72)
Total internal gains													
	622.7744	618.0358	593.9694	556.5020	517.9177	483.4571	463.3708	472.2531	493.8584	531.5515	573.4853	605.4262	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.2900	22.3313	0.4600	0.0000	0.7700	26.0231	(76)
South	8.0600	50.9848	0.4600	0.0000	0.7700	145.5541	(78)
West	4.3100	22.3313	0.4600	0.0000	0.7700	34.0910	(80)
West	3.3300	22.3313	0.4600	0.0000	0.7700	26.3395	(80)

Solar gains	232.0077	366.0594	515.7805	684.3362	762.2292	814.9564	775.2491	716.2702	615.5791	438.7545	287.0391	195.0719	(83)
Total gains	854.7822	984.0951	1109.7499	1240.8382	1280.1468	1298.4135	1238.6199	1188.5233	1109.4375	970.3060	860.5244	800.4981	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7067	32.8471	32.8471	33.0470	33.0470	33.2926	33.2335	33.3502	33.2926	33.1729	33.1729	32.9819	
alpha	3.1804	3.1898	3.1898	3.2031	3.2031	3.2195	3.2156	3.2233	3.2195	3.2115	3.2115	3.1988	
util living area													
	0.9522	0.9272	0.8751	0.7742	0.6268	0.4230	0.2836	0.3032	0.5469	0.8020	0.9202	0.9593	(86)
MIT	19.4888	19.7258	20.1152	20.5326	20.8236	20.9653	20.9933	20.9916	20.9155	20.5582	19.9741	19.4402	(87)
Th 2	19.9269	19.9309	19.9309	19.9367	19.9367	19.9437	19.9420	19.9453	19.9437	19.9403	19.9403	19.9348	(88)
util rest of house													
	0.9432	0.9140	0.8527	0.7353	0.5650	0.3404	0.1885	0.2055	0.4635	0.7581	0.9033	0.9515	(89)
MIT 2	17.9634	18.3017	18.8466	19.4113	19.7713	19.9224	19.9401	19.9427	19.8810	19.4627	18.6670	17.8996	(90)
Living area fraction										fLA = Living area / (4) =		0.1927	(91)
MIT	18.2574	18.5762	19.0911	19.6274	19.9741	20.1234	20.1431	20.1449	20.0804	19.6738	18.9190	18.1966	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1074	18.4262	18.9411	19.4774	19.8241	19.9734	19.9931	19.9949	19.9304	19.5238	18.7690	18.0466	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9226	0.8902	0.8277	0.7164	0.5579	0.3428	0.1932	0.2101	0.4624	0.7381	0.8791	0.9324	(94)
Useful gains	788.5950	876.0785	918.5014	888.9639	714.2438	445.0556	239.2777	249.7573	513.0058	716.1731	756.5135	746.3448	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1517.2066	1489.6720	1340.4202	1105.6216	787.7771	455.3073	240.2714	251.0784	542.0471	911.2583	1238.4576	1497.5097	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	542.0871	412.3348	313.9076	155.9935	54.7087	0.0000	0.0000	0.0000	0.0000	145.1434	346.9998	558.8667	(98)
Space heating												2530.0416	(98)
Space heating per m2											(98) / (4) =	25.8431	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2795.6260	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	542.0871	412.3348	313.9076	155.9935	54.7087	0.0000	0.0000	0.0000	0.0000	145.1434	346.9998	558.8667	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	598.9912	455.6186	346.8593	172.3686	60.4516	0.0000	0.0000	0.0000	0.0000	160.3794	383.4252	617.5322	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	148.6156	113.2799	91.1739	45.6620	21.4954	0.0000	0.0000	20.9300	44.9191	90.3882	124.8034	148.1845	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7918	89.7907	89.7595	89.7550	89.5738	87.3000	87.3000	87.3000	87.3000	89.2446	89.6309	89.8101	(217)
Fuel for water heating, kWh/month	165.5113	126.1600	101.5758	50.8740	23.9974	0.0000	0.0000	23.9748	51.4537	101.2815	139.2415	164.9977	(219)
Water heating fuel used												949.0677	(219)

Annual totals kWh/year		
Space heating fuel - main system	2795.6260	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	402.3561	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	2447.8902	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2795.6260	3.9200	109.5885	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	949.0677	3.9200	37.2035	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	402.3561	16.9600	68.2396	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			14.8541	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2795.6260	0.2160	603.8552	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.0677	0.2160	204.9986	(264)
Space and water heating			808.8538	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	402.3561	0.5190	208.8228	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			135.8128	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2795.6260	1.2200	3410.6638	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.0677	1.2200	1157.8626	(264)
Space and water heating			4568.5263	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	402.3561	3.0700	1235.2333	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			587.3396	(272)
Primary energy kWh/m2/year			5.9994	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	140.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	334.05	(P1)
Transmission heat loss coefficient	69.52	(37)
Summer heat loss coefficient	403.57	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.2900	117.5071	0.4600	0.0000	0.9000	160.0517
South	8.0600	112.2060	0.4600	0.0000	0.9000	374.4135
West	4.3100	117.5071	0.4600	0.0000	0.9000	209.6726
West	3.3300	117.5071	0.4600	0.0000	0.9000	161.9976
total:						906.1353

	Jun	Jul	Aug	
Solar gains	953	906	837	(P4)
Internal gains	480	460	469	
Total summer gains	1433	1367	1306	(P5)
Summer gain/loss ratio	3.55	3.39	3.24	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 140.3)	1.02	1.02	1.02	
Threshold temperature	20.57	22.30	22.06	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-317	**Issued on Date**	19/10/2022
Assessment Reference	Plot 317	**Prop Type Ref**	Badlesmere-As-SEMI
Property	Plot 317, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.50	**TER**	18.89
Environmental	86 B	**% DER<TER**	7.34		
CO_2 Emissions (t/year)	1.16	**DFEE**	47.06	**TFEE**	54.47
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.61		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.89 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.50 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.1 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 0.72 m², No overhang
Windows facing South East: 5.06 m², No overhang
Windows facing North West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	473.1520	551.4617	632.9657	725.3900	794.3325	789.1115	749.3955	684.4926	610.3009	524.8704	464.5299	446.3778	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9877	0.9790	0.9596	0.9104	0.8126	0.6618	0.5202	0.5778	0.7982	0.9406	0.9803	0.9898	(86)
MIT	19.0085	19.2372	19.6224	20.1371	20.5737	20.8535	20.9515	20.9309	20.7073	20.1383	19.4915	18.9795	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9850	0.9744	0.9505	0.8892	0.7672	0.5808	0.4082	0.4651	0.7326	0.9222	0.9752	0.9876	(89)
MIT 2	17.2361	17.5701	18.1282	18.8680	19.4581	19.8065	19.9004	19.8886	19.6487	18.8856	17.9526	17.2024	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6022	17.9145	18.4369	19.1302	19.6886	20.0228	20.1175	20.1039	19.8674	19.1444	18.2705	17.5695	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4522	17.7645	18.2869	18.9802	19.5386	19.8728	19.9675	19.9539	19.7174	18.9944	18.1205	17.4195	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9616	0.9320	0.8664	0.7490	0.5763	0.4127	0.4680	0.7179	0.9011	0.9628	0.9798	(94)
Useful gains	461.8000	530.2688	589.9554	628.4592	594.9442	454.7901	309.2866	320.3170	438.1400	472.9417	447.2489	437.3396	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1305.4834	1272.2506	1161.4872	976.4586	756.8632	501.4471	320.2495	337.0192	537.3650	810.5288	1071.0734	1293.5356	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.7004	498.6118	425.2196	250.5596	120.4678	0.0000	0.0000	0.0000	0.0000	251.1648	449.1537	637.0098	(98)
Space heating												3259.8874	(98)
Space heating per m2											(98) / (4) =	40.8610	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3602.0855	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	627.7004	498.6118	425.2196	250.5596	120.4678	0.0000	0.0000	0.0000	0.0000	251.1648	449.1537	637.0098	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	693.5916	550.9523	469.8559	276.8614	133.1135	0.0000	0.0000	0.0000	0.0000	277.5301	496.3024	703.8783	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8142	89.7594	89.6415	89.3674	88.8225	87.3000	87.3000	87.3000	87.3000	89.3418	89.6839	89.8376	(217)
Fuel for water heating, kWh/month													
	183.8951	161.3661	167.7636	148.1737	144.1432	128.1956	120.4190	135.8687	136.8056	153.8345	165.3956	178.5292	(219)
Water heating fuel used												1824.3899	(219)
Annual totals kWh/year													
Space heating fuel - main system												3602.0855	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Total delivered energy for all uses	5858.3880	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3602.0855	0.2160	778.0505	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.3899	0.2160	394.0682	(264)
Space and water heating			1172.1187	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1396.2813	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.5000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.5000	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.9963	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.9963	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	85.2768	154.6843	236.6837	335.2300	413.7914	427.6485	405.2868	344.1005	270.4043	177.7100	103.8586	71.8684	(83)
Total gains	471.9735	538.9378	606.7831	682.9200	738.7483	730.7017	694.5479	639.9946	578.1468	508.0733	460.0920	447.3348	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9981	0.9960	0.9897	0.9653	0.8897	0.7300	0.5628	0.6263	0.8697	0.9801	0.9962	0.9986	(86)
MIT	19.7022	19.8501	20.1056	20.4558	20.7612	20.9395	20.9868	20.9782	20.8461	20.4544	20.0202	19.6812	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9975	0.9947	0.9858	0.9516	0.8466	0.6384	0.4385	0.4997	0.8026	0.9698	0.9946	0.9981	(89)
MIT 2	18.2027	18.4206	18.7941	19.3043	19.7145	19.9232	19.9591	19.9570	19.8319	19.3111	18.6794	18.1799	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5125	18.7159	19.0650	19.5422	19.9307	20.1331	20.1714	20.1679	20.0414	19.5472	18.9564	18.4900	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5125	18.7159	19.0650	19.5422	19.9307	20.1331	20.1714	20.1679	20.0414	19.5472	18.9564	18.4900	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9923	0.9814	0.9448	0.8455	0.6546	0.4643	0.5257	0.8088	0.9643	0.9924	0.9970	(94)
Useful gains	470.1654	534.7988	595.5126	645.1906	624.6205	478.3121	322.4530	336.4589	467.6264	489.9447	456.5970	446.0112	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1345.4328	1303.9224	1182.3200	987.3094	761.5543	505.5763	326.3303	343.4833	545.5241	827.8482	1102.9541	1336.8330	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	651.1990	516.8511	436.5847	246.3255	101.8788	0.0000	0.0000	0.0000	0.0000	251.4002	465.3771	662.7714	(98)
Space heating												3332.3877	(98)
Space heating per m2											(98) / (4) =	41.7697	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3567.8670	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	651.1990	516.8511	436.5847	246.3255	101.8788	0.0000	0.0000	0.0000	0.0000	251.4002	465.3771	662.7714	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	697.2152	553.3738	467.4354	263.7318	109.0779	0.0000	0.0000	0.0000	0.0000	269.1651	498.2624	709.6054	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7858	87.5864	87.1446	86.0791	83.9724	80.3000	80.3000	80.3000	80.3000	86.0123	87.2996	87.8654	(217)
Fuel for water heating, kWh/month													
	230.1098	202.4061	211.6582	190.0539	188.6220	173.7253	166.4421	185.5439	187.5930	199.4256	209.7437	224.4772	(219)
Water heating fuel used												2369.8007	(219)
Annual totals kWh/year													
Space heating fuel - main system												3567.8670	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6369.5804	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3567.8670	0.2160	770.6593	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2369.8007	0.2160	511.8770	(264)
Space and water heating			1282.5362	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1506.6989	(272)
Emissions per m2 for space and water heating			16.0759	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0759 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)	

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)	
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)													
-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)	
Water heating gains (Table 5)													
43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)	
Total internal gains													
342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)	

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	441.0456	520.1333	603.2523	697.8697	768.2369	765.0198	727.0041	659.9196	584.9504	497.2503	434.3467	415.0440	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
0.9900	0.9821	0.9640	0.9169	0.8209	0.6716	0.5290	0.5900	0.8104	0.9475	0.9836	0.9918	(86)	
MIT	18.9985	19.2278	19.6143	20.1277	20.5684	20.8502	20.9504	20.9281	20.6978	20.1204	19.4718	18.9642	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
0.9878	0.9782	0.9557	0.8970	0.7769	0.5912	0.4168	0.4773	0.7471	0.9310	0.9794	0.9900	(89)	
MIT 2	18.0805	18.3101	18.6936	19.2013	19.6100	19.8528	19.9188	19.9102	19.7388	19.2054	18.5640	18.0545	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2701	18.4996	18.8838	19.3927	19.8079	20.0588	20.1319	20.1205	19.9369	19.3944	18.7515	18.2424	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2701	18.4996	18.8838	19.3927	19.8079	20.0588	20.1319	20.1205	19.9369	19.3944	18.7515	18.2424	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9713	0.9457	0.8851	0.7714	0.6012	0.4385	0.4980	0.7473	0.9205	0.9731	0.9861	(94)
Useful gains	433.6463	505.2206	570.4987	617.6695	592.6208	459.9534	318.7997	328.6260	437.1604	457.7035	422.6514	409.2688	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
1359.7198	1319.7449	1198.2543	1001.3514	771.7560	513.2928	332.1022	349.0394	551.4421	837.0960	1114.9006	1351.0550	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
688.9987	547.3603	467.0501	276.2510	133.2766	0.0000	0.0000	0.0000	0.0000	282.2680	498.4194	700.6889	(98)	
Space heating												3594.3130	(98)
Space heating per m2											(98) / (4) =	45.0528	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8114	0.8711	0.8389	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	717.1899	606.0955	598.1272	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	986.1124	939.8049	863.0181	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	193.6243	248.2798	197.0788	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												638.9829	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	48.4061	62.0700	49.2697	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												159.7457	(107)
Space cooling per m2												2.0023	(108)
Energy for space heating												45.0528	(99)
Energy for space cooling												2.0023	(108)
Total												47.0551	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	85.2768	154.6843	236.6837	335.2300	413.7914	427.6485	405.2868	344.1005	270.4043	177.7100	103.8586	71.8684	(83)
Total gains	427.4881	495.5413	565.6238	644.5741	702.4515	697.0313	662.5708	605.2137	541.9609	468.9976	417.8351	403.6182	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9988	0.9973	0.9923	0.9721	0.9052	0.7537	0.5866	0.6555	0.8917	0.9856	0.9975	0.9991	(86)
MIT	19.6506	19.8002	20.0596	20.4175	20.7360	20.9300	20.9842	20.9733	20.8232	20.4124	19.9715	19.6302	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9984	0.9963	0.9894	0.9607	0.8658	0.6630	0.4587	0.5261	0.8309	0.9779	0.9965	0.9988	(89)
MIT 2	18.6995	18.8511	19.1113	19.4732	19.7698	19.9310	19.9599	19.9583	19.8563	19.4744	19.0332	18.6881	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8960	19.0471	19.3072	19.6683	19.9694	20.1374	20.1715	20.1680	20.0560	19.6682	19.2270	18.8827	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8960	19.0471	19.3072	19.6683	19.9694	20.1374	20.1715	20.1680	20.0560	19.6682	19.2270	18.8827	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9952	0.9871	0.9569	0.8666	0.6797	0.4854	0.5530	0.8377	0.9751	0.9955	0.9984	(94)
Useful gains	426.5480	493.1436	558.3069	616.7684	608.7375	473.7413	321.6152	334.7070	453.9968	457.2987	415.9417	402.9524	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1381.7359	1335.1815	1205.1141	999.0044	765.1287	505.9680	326.3394	343.4863	546.8623	839.0388	1128.1314	1373.5691	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	710.6598	565.8495	481.2246	275.2099	116.3550	0.0000	0.0000	0.0000	0.0000	284.0147	512.7766	722.1388	(98)
Space heating												3668.2289	(98)
Space heating per m2											(98) / (4) =	45.9793	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8562	0.9184	0.8882	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	735.4125	620.9862	615.3373	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	906.6454	864.4932	799.0762	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	123.2877	181.1691	136.7017	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												441.1586	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	30.8219	45.2923	34.1754	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												110.2896 (107)
Space cooling per m2												1.3824 (108)
Energy for space heating												45.9793 (99)
Energy for space cooling												1.3824 (108)
Total												47.3617 (109)
Target Fabric Energy Efficiency (TFEE)												54.5 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(75)
Southeast	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(77)
Northwest	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(81)
Northwest	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(81)

Solar gains	110.2053	180.5118	274.3664	402.5000	485.0733	536.6878	503.0716	436.2382	340.5403	221.8776	137.6336	91.9011 (83)
Total gains	664.1977	730.1017	802.5759	897.5966	946.2962	967.5760	916.2442	857.6921	781.0636	695.7253	648.4981	630.7431 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area	0.9634	0.9488	0.9125	0.8272	0.6789	0.4622	0.3136	0.3426	0.6182	0.8540	0.9410	0.9679	(86)
MIT	19.4954	19.6788	20.0373	20.4736	20.8028	20.9627	20.9928	20.9904	20.8955	20.5028	19.9528	19.4709	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house	0.9559	0.9385	0.8943	0.7919	0.6158	0.3727	0.2083	0.2324	0.5293	0.8154	0.9271	0.9613	(89)
MIT 2	17.9573	18.2229	18.7306	19.3317	19.7441	19.9167	19.9348	19.9388	19.8612	19.3895	18.6283	17.9300	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2750	18.5237	19.0006	19.5675	19.9628	20.1328	20.1534	20.1560	20.0749	19.6195	18.9019	18.2483	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1250	18.3737	18.8506	19.4175	19.8128	19.9828	20.0034	20.0060	19.9249	19.4695	18.7519	18.0983	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9388	0.9188	0.8717	0.7722	0.6083	0.3765	0.2150	0.2392	0.5280	0.7950	0.9065	0.9454	(94)
Useful gains	623.5634	670.8279	699.6343	693.1503	575.5910	364.2913	196.9675	205.1878	412.3725	553.1348	587.8907	596.3171	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1253.6709	1221.9466	1095.3757	902.5579	646.0633	373.6842	197.8559	206.4610	443.3085	742.1960	1014.0500	1236.1449	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	468.7999	370.3518	294.4317	150.7735	52.4314	0.0000	0.0000	0.0000	0.0000	140.6615	306.8347	476.0319	(98)

Space heating 2260.3164 (98)
RHI space heating demand 2260 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	652.8268	728.8662	802.5217	883.6221	940.7997	926.5252	882.8928	820.2602	753.9171	679.8104	631.2348	622.1362	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9700	0.9557	0.9270	0.8623	0.7497	0.5910	0.4526	0.4997	0.7155	0.8908	0.9548	0.9739	(86)
MIT	19.2860	19.4997	19.8513	20.3083	20.6748	20.8964	20.9680	20.9553	20.7958	20.3271	19.7396	19.2553	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9639	0.9469	0.9121	0.8338	0.6985	0.5112	0.3508	0.3958	0.6422	0.8618	0.9443	0.9686	(89)
MIT 2	17.6360	17.9450	18.4484	19.0946	19.5761	19.8447	19.9099	19.9041	19.7407	19.1374	18.3055	17.6006	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9768	18.2662	18.7382	19.3453	19.8030	20.0619	20.1285	20.1213	19.9586	19.3832	18.6018	17.9424	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8268	18.1162	18.5882	19.1953	19.6530	19.9119	19.9785	19.9713	19.8086	19.2332	18.4518	17.7924	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9481	0.9278	0.8895	0.8116	0.6848	0.5101	0.3559	0.4001	0.6337	0.8393	0.9251	0.9541	(94)
Useful gains	618.9311	676.2563	713.8235	717.1310	644.2710	472.5934	314.2437	328.1747	477.7306	570.5377	583.9833	593.5799	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1342.6691	1307.0321	1191.1782	997.2957	767.9172	505.1681	321.2925	338.6675	546.0944	833.5888	1103.2683	1330.0252	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	538.4610	423.8814	355.1520	201.7186	91.9928	0.0000	0.0000	0.0000	0.0000	195.7100	373.8852	547.9153	(98)
Space heating												2728.7162	(98)
Space heating per m2											(98) / (4) =	34.2030	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3015.1560	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	538.4610	423.8814	355.1520	201.7186	91.9928	0.0000	0.0000	0.0000	0.0000	195.7100	373.8852	547.9153	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	594.9846	468.3772	392.4331	222.8935	101.6495	0.0000	0.0000	0.0000	0.0000	216.2541	413.1328	605.4313	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7280	89.6630	89.5238	89.2042	88.6100	87.3000	87.3000	87.3000	87.3000	89.1519	89.5674	89.7550	(217)
Fuel for water heating, kWh/month													
	184.0718	161.5396	167.9842	148.4448	144.4889	128.1956	120.4190	135.8687	136.8056	154.1622	165.6106	178.6936	(219)
Water heating fuel used												1826.2846	(219)
Annual totals kWh/year													
Space heating fuel - main system												3015.1560	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5273.3532	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3015.1560	3.4800	104.9274	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.2846	3.4800	63.5547	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			345.4514	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1628	(257)
SAP value		83.7795	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3015.1560	0.2160	651.2737	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.2846	0.2160	394.4775	(264)
Space and water heating			1045.7512	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1269.9138	(272)
CO2 emissions per m2			15.9200	(273)
EI value			86.3625	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(75)
Southeast	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(77)
Northwest	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(81)
Northwest	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(81)

Solar gains	110.2053	180.5118	274.3664	402.5000	485.0733	536.6878	503.0716	436.2382	340.5403	221.8776	137.6336	91.9011	(83)
Total gains	664.1977	730.1017	802.5759	897.5966	946.2962	967.5760	916.2442	857.6921	781.0636	695.7253	648.4981	630.7431	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9634	0.9488	0.9125	0.8272	0.6789	0.4622	0.3136	0.3426	0.6182	0.8540	0.9410	0.9679	(86)
MIT	19.4954	19.6788	20.0373	20.4736	20.8028	20.9627	20.9928	20.9904	20.8955	20.5028	19.9528	19.4709	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9559	0.9385	0.8943	0.7919	0.6158	0.3727	0.2083	0.2324	0.5293	0.8154	0.9271	0.9613	(89)
MIT 2	17.9573	18.2229	18.7306	19.3317	19.7441	19.9167	19.9348	19.9388	19.8612	19.3895	18.6283	17.9300	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2750	18.5237	19.0006	19.5675	19.9628	20.1328	20.1534	20.1560	20.0749	19.6195	18.9019	18.2483	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1250	18.3737	18.8506	19.4175	19.8128	19.9828	20.0034	20.0060	19.9249	19.4695	18.7519	18.0983	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9388	0.9188	0.8717	0.7722	0.6083	0.3765	0.2150	0.2392	0.5280	0.7950	0.9065	0.9454	(94)
Useful gains	623.5634	670.8279	699.6343	693.1503	575.5910	364.2913	196.9675	205.1878	412.3725	553.1348	587.8907	596.3171	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1253.6709	1221.9466	1095.3757	902.5579	646.0633	373.6842	197.8559	206.4610	443.3085	742.1960	1014.0500	1236.1449	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	468.7999	370.3518	294.4317	150.7735	52.4314	0.0000	0.0000	0.0000	0.0000	140.6615	306.8347	476.0319	(98)
Space heating												2260.3164	(98)
Space heating per m2											(98) / (4) =	28.3319	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2497.5872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	468.7999	370.3518	294.4317	150.7735	52.4314	0.0000	0.0000	0.0000	0.0000	140.6615	306.8347	476.0319	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	518.0110	409.2285	325.3388	166.6005	57.9353	0.0000	0.0000	0.0000	0.0000	155.4271	339.0439	526.0021	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6439	89.5769	89.3922	88.9750	88.2062	87.3000	87.3000	87.3000	87.3000	88.8897	89.4317	89.6716	(217)
Fuel for water heating, kWh/month													
	184.2444	161.6949	168.2315	148.8272	145.1504	128.1956	120.4190	135.8687	136.8056	154.6167	165.8620	178.8598	(219)
Water heating fuel used												1828.7757	(219)
Annual totals kWh/year													
Space heating fuel - main system												2497.5872	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4758.2755	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2497.5872	3.9200	97.9054	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.7757	3.9200	71.6880	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			330.8458	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2497.5872	0.2160	539.4788	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.7757	0.2160	395.0156	(264)
Space and water heating			934.4944	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1158.6570	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2497.5872	1.2200	3047.0564	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.7757	1.2200	2231.1064	(264)
Space and water heating			5278.1627	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6604.1345	(272)
Primary energy kWh/m2/year			82.7793	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.7%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (96.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£258	£220	£38
Space heating	£199	£199	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£331	-£7	£339
Total cost of uses	£332	-£6	£338
Delivered energy	60 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	0 kg/m²	14 kg/m²
Primary energy	83 kWh/m²	0 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)

Combi loss

14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input

-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)

Solar input (sum of months) = Sum(63)m = -843.3953 (63)

Output from w/h

140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)

Total per year (kWh/year) = Sum(64)m = 786.4412 (64)

Heat gains from water heating, kWh/month

53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)

Pumps, fans

3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)

Water heating gains (Table 5)

72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)

Total internal gains

553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	98.8343	179.2763	274.3122	388.5255	479.5768	495.6370	469.7202	398.8064	313.3938	205.9627	120.3703	83.2942	(83)
Total gains	652.8268	728.8662	802.5217	883.6221	940.7997	926.5252	882.8928	820.2602	753.9171	679.8104	631.2348	622.1362	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area	0.9700	0.9557	0.9270	0.8623	0.7497	0.5910	0.4526	0.4997	0.7155	0.8908	0.9548	0.9739	(86)
MIT	19.2860	19.4997	19.8513	20.3083	20.6748	20.8964	20.9680	20.9553	20.7958	20.3271	19.7396	19.2553	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house	0.9639	0.9469	0.9121	0.8338	0.6985	0.5112	0.3508	0.3958	0.6422	0.8618	0.9443	0.9686	(89)
MIT 2	17.6360	17.9450	18.4484	19.0946	19.5761	19.8447	19.9099	19.9041	19.7407	19.1374	18.3055	17.6006	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9768	18.2662	18.7382	19.3453	19.8030	20.0619	20.1285	20.1213	19.9586	19.3832	18.6018	17.9424	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8268	18.1162	18.5882	19.1953	19.6530	19.9119	19.9785	19.9713	19.8086	19.2332	18.4518	17.7924	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9481	0.9278	0.8895	0.8116	0.6848	0.5101	0.3559	0.4001	0.6337	0.8393	0.9251	0.9541	(94)
Useful gains	618.9311	676.2563	713.8235	717.1310	644.2710	472.5934	314.2437	328.1747	477.7306	570.5377	583.9833	593.5799	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1342.6691	1307.0321	1191.1782	997.2957	767.9172	505.1681	321.2925	338.6675	546.0944	833.5888	1103.2683	1330.0252	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	538.4610	423.8814	355.1520	201.7186	91.9928	0.0000	0.0000	0.0000	0.0000	195.7100	373.8852	547.9153	(98)
Space heating												2728.7162	(98)
Space heating per m2											(98) / (4) =	34.2030	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3015.1560	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	538.4610	423.8814	355.1520	201.7186	91.9928	0.0000	0.0000	0.0000	0.0000	195.7100	373.8852	547.9153	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	594.9846	468.3772	392.4331	222.8935	101.6495	0.0000	0.0000	0.0000	0.0000	216.2541	413.1328	605.4313	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8179	89.8510	89.8888	89.9627	90.0925	87.3000	87.3000	87.3000	87.3000	89.5044	89.7045	89.8302	(217)
Fuel for water heating, kWh/month	156.6582	115.7805	89.9772	43.6478	14.3740	0.0000	0.0000	24.1300	49.2919	95.2652	133.0189	155.7609	(219)
Water heating fuel used												877.9046	(219)
Annual totals kWh/year													
Space heating fuel - main system												3015.1560	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2647.7339	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3015.1560	3.4800	104.9274	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9046	3.4800	30.5511	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			91.2199	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3070	(257)
SAP value	95.7168	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3015.1560	0.2160	651.2737	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9046	0.2160	189.6274	(264)
Space and water heating			840.9011	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			194.5765	(272)
CO2 emissions per m2			2.4400	(273)
EI value			97.9105	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3147 (H8)
Utilisation factor                                                                                                                  0.5326 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -859.2180 (H17)
Solar input    -26.4463   -39.7487   -66.9419   -92.5342  -111.4423  -117.2882  -114.4719  -102.2241   -79.7862   -54.2771   -32.1462   -21.9109 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -859.2180 (63)
Output from w/h
             138.7176   105.0925    83.4439    39.8847    16.5893     0.0000     0.0000    16.3893    39.6451    83.1613   116.1870   138.4756 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =     777.5864 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2     or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
Northeast                              0.7200           12.9236           0.4600           0.0000           0.7700            3.2958 (75)
Southeast                              5.0600           40.4699           0.4600           0.0000           0.7700           72.5323 (77)
Northwest                              3.0000           12.9236           0.4600           0.0000           0.7700           13.7326 (81)
Northwest                              4.5100           12.9236           0.4600           0.0000           0.7700           20.6446 (81)
-------------------------------------------------------------------------------------------------------------

Solar gains    110.2053   180.5118   274.3664   402.5000   485.0733   536.6878   503.0716   436.2382   340.5403   221.8776   137.6336    91.9011 (83)
Total gains    664.1977   730.1017   802.5759   897.5966   946.2962   967.5760   916.2442   857.6921   781.0636   695.7253   648.4981   630.7431 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.7290    34.9430    34.9430    35.2490    35.2490    35.6271    35.5359    35.7161    35.6271    35.4424    35.4424    35.1491
alpha         3.3153     3.3295     3.3295     3.3499     3.3499     3.3751     3.3691     3.3811     3.3751     3.3628     3.3628     3.3433
util living area
               0.9634     0.9488     0.9125     0.8272     0.6789     0.4622     0.3136     0.3426     0.6182     0.8540     0.9410     0.9679 (86)

MIT           19.4954    19.6788    20.0373    20.4736    20.8028    20.9627    20.9928    20.9904    20.8955    20.5028    19.9528    19.4709 (87)
Th 2          19.9148    19.9207    19.9207    19.9291    19.9291    19.9392    19.9368    19.9416    19.9392    19.9343    19.9343    19.9264 (88)
util rest of house
               0.9559     0.9385     0.8943     0.7919     0.6158     0.3727     0.2083     0.2324     0.5293     0.8154     0.9271     0.9613 (89)
MIT 2         17.9573    18.2229    18.7306    19.3317    19.7441    19.9167    19.9348    19.9388    19.8612    19.3895    18.6283    17.9300 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.2750    18.5237    19.0006    19.5675    19.9628    20.1328    20.1534    20.1560    20.0749    19.6195    18.9019    18.2483 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1250    18.3737    18.8506    19.4175    19.8128    19.9828    20.0034    20.0060    19.9249    19.4695    18.7519    18.0983 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9388	0.9188	0.8717	0.7722	0.6083	0.3765	0.2150	0.2392	0.5280	0.7950	0.9065	0.9454	(94)
Useful gains	623.5634	670.8279	699.6343	693.1503	575.5910	364.2913	196.9675	205.1878	412.3725	553.1348	587.8907	596.3171	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1253.6709	1221.9466	1095.3757	902.5579	646.0633	373.6842	197.8559	206.4610	443.3085	742.1960	1014.0500	1236.1449	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	468.7999	370.3518	294.4317	150.7735	52.4314	0.0000	0.0000	0.0000	0.0000	140.6615	306.8347	476.0319	(98)
Space heating												2260.3164	(98)
Space heating per m2											(98) / (4) =	28.3319	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2497.5872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	468.7999	370.3518	294.4317	150.7735	52.4314	0.0000	0.0000	0.0000	0.0000	140.6615	306.8347	476.0319	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	518.0110	409.2285	325.3388	166.6005	57.9353	0.0000	0.0000	0.0000	0.0000	155.4271	339.0439	526.0021	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7488	89.7726	89.7733	89.8113	89.7096	87.3000	87.3000	87.3000	87.3000	89.2840	89.5980	89.7586	(217)
Fuel for water heating, kWh/month	154.5620	117.0652	92.9496	44.4095	18.4922	0.0000	0.0000	18.7735	45.4125	93.1425	129.6760	154.2755	(219)
Water heating fuel used												868.7585	(219)

Annual totals kWh/year		
Space heating fuel - main system	2497.5872	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596	-1824.1596	(233)
Total delivered energy for all uses	2024.0987	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2497.5872	3.9200	97.9054	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.7585	3.9200	34.0553	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-7.6843	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2497.5872	0.2160	539.4788	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.7585	0.2160	187.6518	(264)
Space and water heating			727.1307	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			30.5045	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2497.5872	1.2200	3047.0564	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.7585	1.2200	1059.8853	(264)
Space and water heating			4106.9417	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-13.7566	(272)
Primary energy kWh/m2/year			-0.1724	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
South East	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North West	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
North West	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						588.0057

	Jun	Jul	Aug	
Solar gains	627	588	510	(P4)
Internal gains	428	410	418	
Total summer gains	1055	998	928	(P5)
Summer gain/loss ratio	3.22	3.04	2.83	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.16	21.89	21.57	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-318	**Issued on Date**	19/10/2022
Assessment Reference	Plot 318	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	Plot 318, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.42	**TER**	18.80
Environmental	86 B	**% DER<TER**	7.32		
CO_2 Emissions (t/year)	1.15	**DFEE**	46.69	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.57		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.42 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 5.06 m², No overhang
Windows facing South West: 0.72 m², No overhang
Windows facing North West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745 (83)
Total gains	479.6579	561.5879	644.2821	735.1563	801.3877	794.4072	755.2121	692.5931	621.1219	535.3775	472.1484	452.0581 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9872	0.9779	0.9577	0.9076	0.8095	0.6589	0.5169	0.5726	0.7918	0.9376	0.9794	0.9894	(86)
MIT	19.0188	19.2528	19.6386	20.1487	20.5793	20.8555	20.9524	20.9327	20.7152	20.1522	19.5033	18.9887	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9845	0.9732	0.9482	0.8860	0.7638	0.5778	0.4053	0.4604	0.7254	0.9185	0.9741	0.9871	(89)
MIT 2	17.2511	17.5925	18.1511	18.8835	19.4647	19.8084	19.9009	19.8898	19.6572	18.9046	17.9696	17.2157	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6163	17.9355	18.4583	19.1449	19.6950	20.0247	20.1181	20.1052	19.8758	19.1623	18.2865	17.5820	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4663	17.7855	18.3083	18.9949	19.5450	19.8747	19.9681	19.9552	19.7258	19.0123	18.1365	17.4320	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9599	0.9294	0.8630	0.7458	0.5735	0.4099	0.4634	0.7112	0.8971	0.9613	0.9791	(94)
Useful gains	467.7474	539.0535	598.7980	634.4745	597.6653	455.6284	309.5655	320.9251	441.7294	480.2665	453.8822	442.6007	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1306.8780	1274.3286	1163.6010	977.8810	757.4813	501.6242	320.3083	337.1474	538.1691	812.2641	1072.6228	1294.7530	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.3132	494.1048	420.2134	247.2526	118.9031	0.0000	0.0000	0.0000	0.0000	247.0062	445.4932	634.0013	(98)
Space heating												3231.2878	(98)
Space heating per m2											(98) / (4) =	40.5025	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3570.4838	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.3132	494.1048	420.2134	247.2526	118.9031	0.0000	0.0000	0.0000	0.0000	247.0062	445.4932	634.0013	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	689.8488	545.9722	464.3242	273.2073	131.3846	0.0000	0.0000	0.0000	0.0000	272.9350	492.2577	700.5539	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8113	89.7542	89.6341	89.3576	88.8121	87.3000	87.3000	87.3000	87.3000	89.3294	89.6789	89.8352	(217)
Fuel for water heating, kWh/month													
	183.9011	161.3754	167.7776	148.1899	144.1601	128.1956	120.4190	135.8687	136.8056	153.8557	165.4048	178.5342	(219)
Water heating fuel used												1824.4876	(219)
Annual totals kWh/year													
Space heating fuel - main system												3570.4838	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5826.8841	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3570.4838	0.2160	771.2245	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.4876	0.2160	394.0893	(264)
Space and water heating			1165.3138	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1389.4765	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.4200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.4200	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.9163	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.9163	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	477.5869	547.6749	616.5471	691.3466	744.8356	735.2710	699.5666	646.9839	587.4835	517.1391	466.6654	452.2359	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9980	0.9957	0.9889	0.9637	0.8870	0.7269	0.5592	0.6206	0.8638	0.9786	0.9960	0.9985	(86)
MIT	19.7087	19.8601	20.1164	20.4641	20.7652	20.9407	20.9872	20.9790	20.8516	20.4640	20.0278	19.6869	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9973	0.9943	0.9849	0.9494	0.8433	0.6351	0.4355	0.4946	0.7952	0.9677	0.9943	0.9980	(89)
MIT 2	18.2122	18.4352	18.8096	19.3156	19.7192	19.9241	19.9593	19.9574	19.8374	19.3243	18.6903	18.1882	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9918	0.9803	0.9426	0.8424	0.6514	0.4611	0.5206	0.8020	0.9621	0.9920	0.9969	(94)
Useful gains	475.6656	543.1912	604.4008	651.6306	627.4780	478.9734	322.5858	336.8015	471.1769	497.5321	462.9126	450.8347	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1346.2718	1305.2056	1183.6873	988.2939	761.9733	505.6645	326.3480	343.5284	546.0281	829.0043	1103.9086	1337.5610	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating												3301.1128	(98)
Space heating per m2											(98) / (4) =	41.3777	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3534.3820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	693.5022	548.2588	461.4445	259.5263	107.1355	0.0000	0.0000	0.0000	0.0000	264.0421	494.1297	706.3430	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7754	87.5675	87.1161	86.0393	83.9305	80.3000	80.3000	80.3000	80.3000	85.9645	87.2817	87.8566	(217)
Fuel for water heating, kWh/month													
	230.1369	202.4498	211.7275	190.1418	188.7161	173.7253	166.4421	185.5439	187.5930	199.5363	209.7868	224.4996	(219)
Water heating fuel used												2370.2991	(219)
Annual totals kWh/year													
Space heating fuel - main system												3534.3820	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6336.5938	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3534.3820	0.2160	763.4265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.2991	0.2160	511.9846	(264)
Space and water heating			1275.4111	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1499.5738	(272)
Emissions per m2 for space and water heating			15.9866	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9866 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	447.5515	530.2595	614.5686	707.6361	775.2921	770.3155	732.8207	668.0200	595.7713	507.7574	441.9653	420.7243	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9895	0.9811	0.9621	0.9141	0.8178	0.6685	0.5256	0.5846	0.8040	0.9446	0.9828	0.9915	(86)
MIT	19.0090	19.2437	19.6308	20.1395	20.5741	20.8523	20.9513	20.9301	20.7061	20.1348	19.4838	18.9735	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9873	0.9769	0.9535	0.8937	0.7734	0.5882	0.4138	0.4723	0.7396	0.9274	0.9784	0.9896	(89)
MIT 2	18.0909	18.3257	18.7096	19.2122	19.6147	19.8541	19.9192	19.9111	19.7451	19.2189	18.5758	18.0637	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2805	18.5153	18.8998	19.4038	19.8129	20.0603	20.1324	20.1216	19.9436	19.4081	18.7634	18.2517	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2805	18.5153	18.8998	19.4038	19.8129	20.0603	20.1324	20.1216	19.9436	19.4081	18.7634	18.2517	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9825	0.9699	0.9433	0.8818	0.7681	0.5983	0.4355	0.4930	0.7404	0.9167	0.9718	0.9856	(94)
Useful gains	439.7408	514.2881	579.7164	624.0133	595.5179	460.8718	319.1219	329.3351	441.1086	465.4776	429.5150	414.6466	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1360.7360	1321.2651	1199.8110	1002.4138	772.2257	513.4322	332.1503	349.1455	552.0724	838.3971	1116.0390	1351.9426	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	685.2204	542.2885	461.3504	272.4484	131.4706	0.0000	0.0000	0.0000	0.0000	277.4521	494.2973	697.3482	(98)
Space heating												3561.8758	(98)
Space heating per m2											(98) / (4) =	44.6462	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8136	0.8730	0.8423	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	719.1125	607.4625	600.5834	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	992.3023	946.6035	872.4862	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	196.6966	252.3209	202.2957	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												651.3132	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	49.1742	63.0802	50.5739	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												162.8283	(107)
Space cooling per m2												2.0410	(108)
Energy for space heating												44.6462	(99)
Energy for space cooling												2.0410	(108)
Total												46.6872	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(81)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	433.1016	504.2784	575.3879	653.0008	708.5389	701.6006	667.5895	612.2030	551.2975	478.0634	424.4085	408.5193	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9987	0.9970	0.9917	0.9707	0.9027	0.7505	0.5827	0.6495	0.8862	0.9844	0.9974	0.9991	(86)
MIT	19.6571	19.8103	20.0706	20.4261	20.7404	20.9314	20.9847	20.9744	20.8293	20.4223	19.9791	19.6360	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9983	0.9960	0.9886	0.9588	0.8626	0.6596	0.4554	0.5206	0.8236	0.9762	0.9962	0.9987	(89)
MIT 2	18.7060	18.8611	19.1221	19.4812	19.7733	19.9318	19.9601	19.9587	19.8607	19.4839	19.0407	18.6938	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9948	0.9862	0.9549	0.8636	0.6763	0.4820	0.5474	0.8309	0.9732	0.9952	0.9983	(94)
Useful gains	432.0941	501.6546	567.4314	623.5564	611.8767	474.5116	321.7777	335.1368	458.0803	465.2667	422.3545	407.8088	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1382.3519	1336.1274	1206.1322	999.7594	765.4717	506.0479	326.3571	343.5322	547.3010	839.9201	1128.8358	1374.1031	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	706.9918	560.7658	475.1934	270.8661	114.2746	0.0000	0.0000	0.0000	0.0000	278.7422	508.6665	718.9230	(98)
Space heating												3634.4234	(98)
Space heating per m2											(98) / (4) =	45.5556	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8585	0.9202	0.8915	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	737.3479	622.1787	617.6341	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	911.9861	870.3592	807.2455	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	125.7395	184.6463	141.0709	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												451.4567	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	31.4349	46.1616	35.2677	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												112.8642 (107)
Space cooling per m2												1.4147 (108)
Energy for space heating												45.5556 (99)
Energy for space cooling												1.4147 (108)
Total												46.9703 (109)
Target Fabric Energy Efficiency (TFEE)												54.0 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)
Total per year (kWh/year) = Sum(64)m =												1622.0849 (64)
RHI water heating demand												1622 (64)
Heat gains from water heating, kWh/month												
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(77)
Southwest	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(79)
Northwest	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(81)
Northwest	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(81)

Solar gains	117.2303	190.2581	284.9360	411.6500	491.3072	541.5794	508.4467	444.1451	351.3902	232.6113	146.0402	97.9896	(83)
Total gains	671.2227	739.8480	813.1455	906.7466	952.5301	972.4675	921.6193	865.5990	791.9135	706.4590	656.9047	636.8316	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9624	0.9471	0.9098	0.8239	0.6761	0.4602	0.3119	0.3397	0.6120	0.8494	0.9391	0.9671	(86)
MIT	19.5057	19.6922	20.0499	20.4813	20.8054	20.9632	20.9929	20.9907	20.8986	20.5129	19.9641	19.4800	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9547	0.9365	0.8912	0.7881	0.6128	0.3709	0.2071	0.2303	0.5233	0.8101	0.9247	0.9603	(89)
MIT 2	17.9719	18.2418	18.7478	19.3412	19.7467	19.9171	19.9349	19.9388	19.8638	19.4019	18.6439	17.9429	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2887	18.5415	19.0168	19.5767	19.9654	20.1332	20.1534	20.1561	20.0776	19.6314	18.9167	18.2604	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1387	18.3915	18.8668	19.4267	19.8154	19.9832	20.0034	20.0061	19.9276	19.4814	18.7667	18.1104	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9374	0.9165	0.8686	0.7687	0.6055	0.3748	0.2137	0.2371	0.5223	0.7900	0.9040	0.9442	(94)
Useful gains	629.1823	678.0764	706.2575	697.0146	576.7757	364.4539	196.9884	205.2336	413.6048	558.0943	593.8608	601.2979	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.9887	1223.6468	1096.9275	903.4299	646.3136	373.7174	197.8608	206.4717	443.5640	743.3238	1015.4383	1237.3004	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating												2237.7694	(98)
RHI space heating demand												2238	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9692	0.9541	0.9245	0.8591	0.7467	0.5885	0.4500	0.4956	0.7096	0.8871	0.9534	0.9732	(86)
MIT	19.2957	19.5140	19.8656	20.3178	20.6789	20.8977	20.9685	20.9564	20.8012	20.3386	19.7504	19.2639	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9630	0.9451	0.9092	0.8303	0.6953	0.5088	0.3486	0.3922	0.6360	0.8574	0.9426	0.9678	(89)
MIT 2	17.6498	17.9652	18.4680	19.1069	19.5808	19.8458	19.9102	19.9048	19.7460	19.1523	18.3206	17.6130	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9898	18.2851	18.7567	19.3570	19.8077	20.0631	20.1288	20.1220	19.9640	19.3974	18.6159	17.9540	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8398	18.1351	18.6067	19.2070	19.6577	19.9131	19.9788	19.9720	19.8140	19.2474	18.4659	17.8040	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9257	0.8865	0.8082	0.6819	0.5078	0.3538	0.3966	0.6278	0.8349	0.9232	0.9531	(94)
Useful gains	624.3229	684.0630	721.4315	722.0134	646.2987	473.1388	314.4043	328.5174	480.0955	576.3699	589.7925	598.3835	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1343.9566	1308.9042	1193.0034	998.4322	768.3643	505.2807	321.3262	338.7391	546.6053	834.9575	1104.6456	1331.1575	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating												2704.2559	(98)
Space heating per m2											(98) / (4) =	33.8964	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2988.1281	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	591.6104	463.9705	387.6790	219.9133	100.3500	0.0000	0.0000	0.0000	0.0000	212.5848	409.6069	602.4132	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7246	89.6571	89.5155	89.1938	88.6000	87.3000	87.3000	87.3000	87.3000	89.1385	89.5618	89.7522	(217)
Fuel for water heating, kWh/month	184.0787	161.5502	167.9997	148.4621	144.5051	128.1956	120.4190	135.8687	136.8056	154.1853	165.6211	178.6993	(219)
Water heating fuel used												1826.3904	(219)
Annual totals kWh/year													
Space heating fuel - main system												2988.1281	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5246.4311	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2988.1281	3.4800	103.9869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.3904	3.4800	63.5584	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			344.5145	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1596	(257)
SAP value		83.8234	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2988.1281	0.2160	645.4357	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.3904	0.2160	394.5003	(264)
Space and water heating			1039.9360	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1264.0986	(272)
CO2 emissions per m2			15.8400	(273)
EI value			86.4250	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(77)
Southwest	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(79)
Northwest	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(81)
Northwest	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(81)

Solar gains	117.2303	190.2581	284.9360	411.6500	491.3072	541.5794	508.4467	444.1451	351.3902	232.6113	146.0402	97.9896	(83)
Total gains	671.2227	739.8480	813.1455	906.7466	952.5301	972.4675	921.6193	865.5990	791.9135	706.4590	656.9047	636.8316	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9624	0.9471	0.9098	0.8239	0.6761	0.4602	0.3119	0.3397	0.6120	0.8494	0.9391	0.9671	(86)
MIT	19.5057	19.6922	20.0499	20.4813	20.8054	20.9632	20.9929	20.9907	20.8986	20.5129	19.9641	19.4800	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9547	0.9365	0.8912	0.7881	0.6128	0.3709	0.2071	0.2303	0.5233	0.8101	0.9247	0.9603	(89)
MIT 2	17.9719	18.2418	18.7478	19.3412	19.7467	19.9171	19.9349	19.9388	19.8638	19.4019	18.6439	17.9429	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2887	18.5415	19.0168	19.5767	19.9654	20.1332	20.1534	20.1561	20.0776	19.6314	18.9167	18.2604	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1387	18.3915	18.8668	19.4267	19.8154	19.9832	20.0034	20.0061	19.9276	19.4814	18.7667	18.1104	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9374	0.9165	0.8686	0.7687	0.6055	0.3748	0.2137	0.2371	0.5223	0.7900	0.9040	0.9442	(94)
Useful gains	629.1823	678.0764	706.2575	697.0146	576.7757	364.4539	196.9884	205.2336	413.6048	558.0943	593.8608	601.2979	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.9887	1223.6468	1096.9275	903.4299	646.3136	373.7174	197.8608	206.4717	443.5640	743.3238	1015.4383	1237.3004	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating												2237.7694	(98)
Space heating per m2											(98) / (4) =	28.0493	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2472.6734	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	514.4750	405.1087	321.1696	164.2200	57.1671	0.0000	0.0000	0.0000	0.0000	152.2770	335.3987	522.8573	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6396	89.5702	89.3828	88.9635	88.1975	87.3000	87.3000	87.3000	87.3000	88.8734	89.4240	89.6680	(217)
Fuel for water heating, kWh/month													
	184.2532	161.7069	168.2491	148.8464	145.1647	128.1956	120.4190	135.8687	136.8056	154.6452	165.8763	178.8671	(219)
Water heating fuel used												1828.8978	(219)
Annual totals kWh/year													
Space heating fuel - main system												2472.6734	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4733.4838	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2472.6734	3.9200	96.9288	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.8978	3.9200	71.6928	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			329.8740	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2472.6734	0.2160	534.0974	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8978	0.2160	395.0419	(264)
Space and water heating			929.1394	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1153.3020	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2472.6734	1.2200	3016.6615	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8978	1.2200	2231.2553	(264)
Space and water heating			5247.9168	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6573.8886	(272)
Primary energy kWh/m2/year			82.4002	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.7%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£257	£219	£38
Space heating	£198	£198	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£330	-£8	£339
Total cost of uses	£331	-£7	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	82 kWh/m²	-1 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9692	0.9541	0.9245	0.8591	0.7467	0.5885	0.4500	0.4956	0.7096	0.8871	0.9534	0.9732	(86)
MIT	19.2957	19.5140	19.8656	20.3178	20.6789	20.8977	20.9685	20.9564	20.8012	20.3386	19.7504	19.2639	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9630	0.9451	0.9092	0.8303	0.6953	0.5088	0.3486	0.3922	0.6360	0.8574	0.9426	0.9678	(89)
MIT 2	17.6498	17.9652	18.4680	19.1069	19.5808	19.8458	19.9102	19.9048	19.7460	19.1523	18.3206	17.6130	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	17.9898	18.2851	18.7567	19.3570	19.8077	20.0631	20.1288	20.1220	19.9640	19.3974	18.6159	17.9540	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8398	18.1351	18.6067	19.2070	19.6577	19.9131	19.9788	19.9720	19.8140	19.2474	18.4659	17.8040	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9257	0.8865	0.8082	0.6819	0.5078	0.3538	0.3966	0.6278	0.8349	0.9232	0.9531	(94)
Useful gains	624.3229	684.0630	721.4315	722.0134	646.2987	473.1388	314.4043	328.5174	480.0955	576.3699	589.7925	598.3835	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1343.9566	1308.9042	1193.0034	998.4322	768.3643	505.2807	321.3262	338.7391	546.6053	834.9575	1104.6456	1331.1575	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating												2704.2559	(98)
Space heating per m2											(98) / (4) =	33.8964	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2988.1281	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	591.6104	463.9705	387.6790	219.9133	100.3500	0.0000	0.0000	0.0000	0.0000	212.5848	409.6069	602.4132	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8149	89.8461	89.8828	89.9566	90.0879	87.3000	87.3000	87.3000	87.3000	89.4926	89.6994	89.8275	(217)
Fuel for water heating, kWh/month													
	156.6635	115.7868	89.9833	43.6507	14.3747	0.0000	0.0000	24.1300	49.2919	95.2778	133.0265	155.7655	(219)
Water heating fuel used												877.9507	(219)
Annual totals kWh/year													
Space heating fuel - main system												2988.1281	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2620.7521	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2988.1281	3.4800	103.9869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9507	3.4800	30.5527	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			90.2809	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3039	(257)
SAP value	95.7609	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2988.1281	0.2160	645.4357	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9507	0.2160	189.6374	(264)
Space and water heating			835.0730	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			188.7484	(272)
CO2 emissions per m2			2.3700	(273)
EI value			97.9730	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3147 (H8)
Utilisation factor                                                                                                                  0.5326 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -859.2180 (H17)
Solar input    -26.4463   -39.7487   -66.9419   -92.5342  -111.4423  -117.2882  -114.4719  -102.2241   -79.7862   -54.2771   -32.1462   -21.9109 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -859.2180 (63)
Output from w/h
             138.7176   105.0925    83.4439    39.8847    16.5893     0.0000     0.0000    16.3893    39.6451    83.1613   116.1870   138.4756 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =     777.5864 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2       or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------
Southeast                              5.0600            40.4699           0.4600           0.0000         0.7700           72.5323 (77)
Southwest                              0.7200            40.4699           0.4600           0.0000         0.7700           10.3208 (79)
Northwest                              3.0000            12.9236           0.4600           0.0000         0.7700           13.7326 (81)
Northwest                              4.5100            12.9236           0.4600           0.0000         0.7700           20.6446 (81)
-------------------------------------------------------------------------------------------------------------

Solar gains    117.2303   190.2581   284.9360   411.6500   491.3072   541.5794   508.4467   444.1451   351.3902   232.6113   146.0402    97.9896 (83)
Total gains    671.2227   739.8480   813.1455   906.7466   952.5301   972.4675   921.6193   865.5990   791.9135   706.4590   656.9047   636.8316 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.7290    34.9430    34.9430    35.2490    35.2490    35.6271    35.5359    35.7161    35.6271    35.4424    35.4424    35.1491
alpha         3.3153     3.3295     3.3295     3.3499     3.3499     3.3751     3.3691     3.3811     3.3751     3.3628     3.3628     3.3433
util living area
               0.9624     0.9471     0.9098     0.8239     0.6761     0.4602     0.3119     0.3397     0.6120     0.8494     0.9391     0.9671 (86)

MIT           19.5057    19.6922    20.0499    20.4813    20.8054    20.9632    20.9929    20.9907    20.8986    20.5129    19.9641    19.4800 (87)
Th 2          19.9148    19.9207    19.9207    19.9291    19.9291    19.9392    19.9368    19.9416    19.9392    19.9343    19.9343    19.9264 (88)
util rest of house
               0.9547     0.9365     0.8912     0.7881     0.6128     0.3709     0.2071     0.2303     0.5233     0.8101     0.9247     0.9603 (89)
MIT 2         17.9719    18.2418    18.7478    19.3412    19.7467    19.9171    19.9349    19.9388    19.8638    19.4019    18.6439    17.9429 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.2887    18.5415    19.0168    19.5767    19.9654    20.1332    20.1534    20.1561    20.0776    19.6314    18.9167    18.2604 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1387    18.3915    18.8668    19.4267    19.8154    19.9832    20.0034    20.0061    19.9276    19.4814    18.7667    18.1104 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9374	0.9165	0.8686	0.7687	0.6055	0.3748	0.2137	0.2371	0.5223	0.7900	0.9040	0.9442	(94)
Useful gains	629.1823	678.0764	706.2575	697.0146	576.7757	364.4539	196.9884	205.2336	413.6048	558.0943	593.8608	601.2979	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.9887	1223.6468	1096.9275	903.4299	646.3136	373.7174	197.8608	206.4717	443.5640	743.3238	1015.4383	1237.3004	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating												2237.7694	(98)
Space heating per m2											(98) / (4) =	28.0493	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2472.6734	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	514.4750	405.1087	321.1696	164.2200	57.1671	0.0000	0.0000	0.0000	0.0000	152.2770	335.3987	522.8573	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7449	89.7669	89.7661	89.8035	89.7017	87.3000	87.3000	87.3000	87.3000	89.2685	89.5909	89.7552	(217)
Fuel for water heating, kWh/month	154.5688	117.0726	92.9571	44.4134	18.4939	0.0000	0.0000	18.7735	45.4125	93.1586	129.6862	154.2814	(219)
Water heating fuel used												868.8179	(219)

Annual totals kWh/year		
Space heating fuel - main system	2472.6734	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	1999.2443	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2472.6734	3.9200	96.9288	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.8179	3.9200	34.0577	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-8.6586	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2472.6734	0.2160	534.0974	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8179	0.2160	187.6647	(264)
Space and water heating			721.7621	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			25.1359 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2472.6734	1.2200	3016.6615	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8179	1.2200	1059.9579	(264)
Space and water heating			4076.6194	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-44.0789	(272)
Primary energy kWh/m2/year			-0.5525	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
South West	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
North West	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
North West	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						594.2884

	Jun	Jul	Aug	
Solar gains	633	594	519	(P4)
Internal gains	428	410	418	
Total summer gains	1061	1004	938	(P5)
Summer gain/loss ratio	3.23	3.06	2.86	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.18	21.91	21.60	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-319	**Issued on Date**	19/10/2022
Assessment Reference	Plot 319	**Prop Type Ref**	Ebbertson-As-SEMI
Property	Plot 319, 3 Bed, K, WC, B, Es		

SAP Rating	85 B	**DER**	16.04	**TER**	17.30
Environmental	86 B	**% DER<TER**	7.29		
CO_2 Emissions (t/year)	1.50	**DFEE**	47.11	**TFEE**	54.42
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.44		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.30 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.04 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.1 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 5.81 m², No overhang
Windows facing South West: 2.16 m², No overhang
Windows facing North West: 7.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	586.8083	693.5016	799.3606	913.5698	995.5734	986.3333	938.1336	860.0337	771.8984	662.6066	579.2824	551.7109	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9888	0.9802	0.9620	0.9173	0.8282	0.6871	0.5466	0.6028	0.8122	0.9446	0.9819	0.9907	(86)
MIT	18.9040	19.1411	19.5342	20.0546	20.5116	20.8197	20.9372	20.9129	20.6652	20.0686	19.3973	18.8683	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9865	0.9763	0.9540	0.8988	0.7879	0.6116	0.4378	0.4949	0.7532	0.9286	0.9776	0.9889	(89)
MIT 2	17.1332	17.4793	18.0497	18.7993	19.4256	19.8173	19.9366	19.9200	19.6440	18.8331	17.8625	17.0876	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6799	17.9923	18.5080	19.1869	19.7609	20.1268	20.2455	20.2266	19.9593	19.2145	18.3363	17.6374	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5299	17.8423	18.3580	19.0369	19.6109	19.9768	20.0955	20.0766	19.8093	19.0645	18.1863	17.4874	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9786	0.9647	0.9374	0.8781	0.7719	0.6119	0.4516	0.5065	0.7423	0.9099	0.9667	0.9821	(94)
Useful gains	574.2630	669.0323	749.2814	802.1814	768.5001	603.5042	423.6244	435.5862	573.0070	602.9388	559.9810	541.8280	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1745.5389	1702.5535	1555.3690	1311.3986	1020.7663	685.3670	445.5650	467.5767	731.1937	1092.2018	1438.0418	1732.9951	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	871.4292	694.5262	599.7292	366.6364	187.6861	0.0000	0.0000	0.0000	0.0000	364.0117	632.2038	886.2283	(98)
Space heating												4602.4510	(98)
Space heating per m2											(98) / (4) =	40.9252	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5085.5812	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	871.4292	694.5262	599.7292	366.6364	187.6861	0.0000	0.0000	0.0000	0.0000	364.0117	632.2038	886.2283	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	962.9052	767.4323	662.6842	405.1231	207.3880	0.0000	0.0000	0.0000	0.0000	402.2228	698.5677	979.2578	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9368	89.8912	89.7953	89.5752	89.1107	87.3000	87.3000	87.3000	87.3000	89.5458	89.8311	89.9580	(217)
Fuel for water heating, kWh/month	199.6273	175.1220	181.9441	160.4839	155.8798	138.9421	130.3772	147.2980	148.3736	166.6173	179.4017	193.7653	(219)
Water heating fuel used												1977.8325	(219)
Annual totals kWh/year													
Space heating fuel - main system												5085.5812	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												7599.0159	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5085.5812	0.2160	1098.4855	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.8325	0.2160	427.2118	(264)
Space and water heating			1525.6974	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/year			1803.6749	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.0400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.0400	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		32.1946	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.1946	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
									Total per year (kWh/year) = Sum(64)m =			2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Southwest	2.1600	36.7938	0.6300	0.7000	0.7700	24.2885	(79)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	120.1523	214.9007	321.3872	444.3181	539.9431	554.6818	527.0103	452.7863	363.4866	244.8701	145.7751	101.6236	(83)
Total gains	580.7450	673.0895	763.1944	859.5155	927.2245	915.3986	871.1790	804.2937	729.5453	637.7704	569.3315	548.4733	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9990	0.9977	0.9934	0.9758	0.9150	0.7686	0.5988	0.6632	0.8960	0.9868	0.9979	0.9993	(86)
MIT	19.7089	19.8538	20.1005	20.4389	20.7428	20.9321	20.9853	20.9757	20.8348	20.4433	20.0191	19.6894	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9987	0.9969	0.9909	0.9658	0.8791	0.6817	0.4741	0.5380	0.8380	0.9798	0.9970	0.9990	(89)
MIT 2	18.2454	18.4593	18.8208	19.3174	19.7337	19.9617	20.0038	20.0009	19.8623	19.3307	18.7108	18.2246	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6972	18.8898	19.2158	19.6636	20.0452	20.2613	20.3068	20.3019	20.1626	19.6742	19.1147	18.6768	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6972	18.8898	19.2158	19.6636	20.0452	20.2613	20.3068	20.3019	20.1626	19.6742	19.1147	18.6768	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9956	0.9883	0.9616	0.8811	0.7057	0.5130	0.5769	0.8489	0.9767	0.9958	0.9985	(94)
Useful gains	579.6012	670.1144	754.2294	826.4890	816.9821	646.0049	446.8787	463.9668	619.2874	622.9046	566.9651	547.6694	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1827.9561	1770.7847	1604.6776	1339.0230	1035.3723	693.5417	454.1109	476.8728	746.3468	1125.8090	1498.7833	1816.1923	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	928.7760	739.6505	632.7335	369.0245	162.4824	0.0000	0.0000	0.0000	0.0000	374.1609	670.9091	943.7811	(98)
Space heating												4821.5179	(98)
Space heating per m2											(98) / (4) =	42.8732	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5162.2247	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	928.7760	739.6505	632.7335	369.0245	162.4824	0.0000	0.0000	0.0000	0.0000	374.1609	670.9091	943.7811	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	994.4069	791.9170	677.4449	395.1011	173.9640	0.0000	0.0000	0.0000	0.0000	400.6005	718.3181	1010.4723	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3017	88.1282	87.7471	86.8310	84.8875	80.3000	80.3000	80.3000	80.3000	86.7749	87.8926	88.3681	(217)
Fuel for water heating, kWh/month	245.0054	216.3601	228.1802	206.2955	204.3032	190.2188	182.2441	203.1594	205.4031	214.4363	223.9174	238.9158	(219)
Water heating fuel used												2558.4393	(219)
Annual totals kWh/year													
Space heating fuel - main system												5162.2247	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8256.2662	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5162.2247	0.2160	1115.0405	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2558.4393	0.2160	552.6229	(264)
Space and water heating			1667.6634	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1945.6410	(272)
Emissions per m2 for space and water heating			14.8289	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8289 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.3000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	552.3775	659.9202	767.5431	884.1511	967.7157	960.6709	914.3338	833.8437	744.8564	633.0820	546.9551	518.1259	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	31.8794	31.9740	32.0673	32.5127	32.5974	32.9977	32.9977	33.0729	32.8424	32.5974	32.4265	32.2497	
alpha	3.1253	3.1316	3.1378	3.1675	3.1732	3.1998	3.1998	3.2049	3.1895	3.1732	3.1618	3.1500	
util living area	0.9900	0.9820	0.9646	0.9215	0.8349	0.6964	0.5565	0.6148	0.8219	0.9491	0.9839	0.9918	(86)
MIT	18.8367	19.0785	19.4801	20.0133	20.4842	20.8061	20.9312	20.9043	20.6419	20.0250	19.3387	18.8012	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9880	0.9784	0.9571	0.9039	0.7958	0.6216	0.4470	0.5068	0.7648	0.9343	0.9800	0.9902	(89)
MIT 2	17.9591	18.2012	18.6003	19.1296	19.5729	19.8576	19.9455	19.9332	19.7292	19.1512	18.4710	17.9315	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2300	18.4720	18.8719	19.4024	19.8543	20.1504	20.2498	20.2330	20.0110	19.4209	18.7389	18.2000	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2300	18.4720	18.8719	19.4024	19.8543	20.1504	20.2498	20.2330	20.0110	19.4209	18.7389	18.2000	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9716	0.9473	0.8925	0.7912	0.6356	0.4783	0.5361	0.7674	0.9245	0.9739	0.9864	(94)
Useful gains	543.2915	641.1851	727.1130	789.1078	765.6225	610.6354	437.2982	446.9960	571.6305	585.2713	532.6725	511.0687	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1837.9192	1785.3868	1622.7833	1358.6937	1052.1702	707.5026	465.2353	487.4781	757.0211	1138.1940	1509.7222	1825.9434	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	963.2030	768.9036	666.3787	410.1019	213.1915	0.0000	0.0000	0.0000	0.0000	411.3745	703.4758	978.2668 (98)
Space heating												5114.8957 (98)
Space heating per m2											(98) / (4) =	45.4819 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1198.1975	943.2619	966.5525	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7712	0.8372	0.8031	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	924.0819	789.6619	776.2652	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1228.1873	1172.0721	1081.5844	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	218.9559	284.5132	227.1575	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												730.6266	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	54.7390	71.1283	56.7894	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												182.6566	(107)
Space cooling per m2												1.6242	(108)
Energy for space heating												45.4819	(99)
Energy for space cooling												1.6242	(108)
Total												47.1061	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Southwest	2.1600	36.7938	0.6300	0.7000	0.7700	24.2885	(79)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	120.1523	214.9007	321.3872	444.3181	539.9431	554.6818	527.0103	452.7863	363.4866	244.8701	145.7751	101.6236	(83)
Total gains	533.9467	627.1364	718.9965	817.8139	887.7665	878.8164	836.4508	766.4955	690.2087	595.8539	524.6262	502.5167	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9993	0.9983	0.9949	0.9802	0.9265	0.7885	0.6200	0.6888	0.9127	0.9902	0.9986	0.9995	(86)
MIT	19.6698	19.8157	20.0645	20.4077	20.7209	20.9231	20.9828	20.9710	20.8149	20.4102	19.9819	19.6509	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9991	0.9977	0.9930	0.9719	0.8938	0.7032	0.4927	0.5620	0.8604	0.9848	0.9979	0.9994	(89)
MIT 2	18.7558	18.9037	19.1539	19.5029	19.7994	19.9718	20.0049	20.0027	19.8929	19.5104	19.0806	18.7456	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	19.0380	19.1853	19.4351	19.7822	20.0839	20.2655	20.3068	20.3017	20.1775	19.7882	19.3588	19.0251	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0380	19.1853	19.4351	19.7822	20.0839	20.2655	20.3068	20.3017	20.1775	19.7882	19.3588	19.0251	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9971	0.9916	0.9696	0.8971	0.7274	0.5326	0.6017	0.8713	0.9833	0.9974	0.9991	(94)
Useful gains	533.3101	625.3102	712.9399	792.9878	796.4538	639.2598	445.5128	461.2053	601.3886	585.9066	523.2643	502.0827	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1871.2249	1808.1873	1632.3411	1353.7768	1040.1697	694.0590	454.1047	476.8491	748.1904	1139.9501	1529.2370	1859.8861	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	995.4086	794.8934	684.0345	403.7681	181.3246	0.0000	0.0000	0.0000	0.0000	412.2084	724.3003	1010.2058	(98)
Space heating												5206.1436	(98)
Space heating per m2											(98) / (4) =	46.2933	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8329	0.9040	0.8706	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	959.1477	819.5095	808.6942	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1132.5131	1081.0400	1002.8657	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	124.8231	194.5787	144.4636	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												463.8655	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	31.2058	48.6447	36.1159	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												115.9664	(107)
Space cooling per m2												1.0312	(108)
Energy for space heating												46.2933	(99)
Energy for space cooling												1.0312	(108)
Total												47.3245	(109)
Target Fabric Energy Efficiency (TFEE)												54.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)
Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	40.4699	0.4600	0.0000	0.7700	83.2831	(77)
Southwest	2.1600	40.4699	0.4600	0.0000	0.7700	30.9624	(79)
Northwest	2.1700	12.9236	0.4600	0.0000	0.7700	9.9332	(81)
Northwest	5.4600	12.9236	0.4600	0.0000	0.7700	24.9933	(81)
Northwest	0.6500	18.7850	0.6300	0.7000	1.0000	4.8463	(82)

Solar gains	154.0183	248.4091	368.4021	526.9910	625.1329	687.5292	646.0844	566.9650	452.4234	302.6271	191.5407	128.9481	(83)
Total gains	822.7806	911.7948	1005.3661	1123.0361	1179.0234	1204.0974	1141.2061	1071.7140	981.0686	872.4232	806.9282	779.0732	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area													
	0.9674	0.9536	0.9204	0.8432	0.7052	0.4913	0.3362	0.3660	0.6435	0.8674	0.9473	0.9716	(86)
MIT	19.3721	19.5620	19.9354	20.3926	20.7570	20.9491	20.9895	20.9863	20.8689	20.4326	19.8461	19.3418	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house													
	0.9611	0.9448	0.9048	0.8120	0.6468	0.4028	0.2290	0.2544	0.5594	0.8335	0.9355	0.9661	(89)
MIT 2	17.8246	18.0999	18.6321	19.2684	19.7372	19.9503	19.9784	19.9807	19.8791	19.3397	18.5191	17.7869	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3023	18.5513	19.0345	19.6155	20.0520	20.2586	20.2906	20.2912	20.1847	19.6771	18.9288	18.2669	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1523	18.4013	18.8845	19.4655	19.9020	20.1086	20.1406	20.1412	20.0347	19.5271	18.7788	18.1169	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9459	0.9271	0.8841	0.7939	0.6421	0.4142	0.2461	0.2720	0.5640	0.8154	0.9171	0.9522	(94)
Useful gains	778.3051	845.2805	888.8166	891.5517	757.1054	498.6913	280.8276	291.4626	553.3236	711.3495	740.0675	741.8048	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1679.8937	1639.4749	1470.8295	1216.5192	877.7837	518.0802	283.1050	294.6229	609.6368	1003.7457	1364.8219	1659.2392	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	670.7820	533.6987	433.0176	233.9766	89.7847	0.0000	0.0000	0.0000	0.0000	217.5428	449.8232	682.5712	(98)
Space heating												3311.1967	(98)
RHI space heating demand												3311	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	807.3453	911.0702	1006.8978	1106.7005	1173.7828	1153.1046	1100.0150	1024.8835	946.7796	851.8943	783.4914	767.3579	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9731	0.9594	0.9328	0.8743	0.7708	0.6197	0.4799	0.5270	0.7365	0.9004	0.9595	0.9768	(86)
MIT	19.1692	19.3922	19.7544	20.2230	20.6160	20.8678	20.9570	20.9413	20.7569	20.2522	19.6348	19.1313	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9680	0.9519	0.9199	0.8494	0.7246	0.5438	0.3793	0.4254	0.6692	0.8753	0.9506	0.9724	(89)
MIT 2	17.5164	17.8394	18.3598	19.0256	19.5516	19.8629	19.9492	19.9398	19.7437	19.0813	18.2020	17.4684	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0267	18.3188	18.7904	19.3953	19.8802	20.1732	20.2603	20.2490	20.0565	19.4428	18.6444	17.9818	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8767	18.1688	18.6404	19.2453	19.7302	20.0232	20.1103	20.0990	19.9065	19.2928	18.4944	17.8318	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9541	0.9347	0.8993	0.8289	0.7130	0.5478	0.3934	0.4384	0.6646	0.8550	0.9337	0.9597	(94)
Useful gains	770.3027	851.5833	905.5234	917.3662	836.8635	631.6236	432.6960	449.2753	629.2255	728.3908	731.5250	736.4622	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1791.3005	1745.4975	1592.4086	1338.3672	1036.1608	691.2783	447.4543	470.4317	743.6458	1121.6602	1477.9988	1777.9232	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	759.6223	600.7103	511.0426	303.1207	148.2772	0.0000	0.0000	0.0000	0.0000	292.5924	537.4611	774.8470	(98)
Space heating												3927.6736	(98)
Space heating per m2											(98) / (4) =	34.9251	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4339.9708	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	759.6223	600.7103	511.0426	303.1207	148.2772	0.0000	0.0000	0.0000	0.0000	292.5924	537.4611	774.8470	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	839.3617	663.7683	564.6879	334.9400	163.8422	0.0000	0.0000	0.0000	0.0000	323.3066	593.8797	856.1845	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8702	89.8164	89.7035	89.4453	88.9234	87.3000	87.3000	87.3000	87.3000	89.3934	89.7412	89.8949	(217)
Fuel for water heating, kWh/month	199.7752	175.2678	182.1304	160.7170	156.2082	138.9421	130.3772	147.2980	148.3736	166.9013	179.5815	193.9015	(219)
Water heating fuel used												1979.4740	(219)
Annual totals kWh/year													
Space heating fuel - main system												4339.9708	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6855.0470	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4339.9708	3.4800	151.0310	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4740	3.4800	68.8857	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Total energy cost			410.5626	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0951	(257)
SAP value		84.7232	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4339.9708	0.2160	937.4337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4740	0.2160	427.5664	(264)
Space and water heating			1365.0001	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1642.9776	(272)
CO2 emissions per m2			14.6100	(273)
EI value			86.0181	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	40.4699	0.4600	0.0000	0.7700	83.2831	(77)
Southwest	2.1600	40.4699	0.4600	0.0000	0.7700	30.9624	(79)
Northwest	2.1700	12.9236	0.4600	0.0000	0.7700	9.9332	(81)
Northwest	5.4600	12.9236	0.4600	0.0000	0.7700	24.9933	(81)
Northwest	0.6500	18.7850	0.6300	0.7000	1.0000	4.8463	(82)

Solar gains	154.0183	248.4091	368.4021	526.9910	625.1329	687.5292	646.0844	566.9650	452.4234	302.6271	191.5407	128.9481	(83)
Total gains	822.7806	911.7948	1005.3661	1123.0361	1179.0234	1204.0974	1141.2061	1071.7140	981.0686	872.4232	806.9282	779.0732	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area	0.9674	0.9536	0.9204	0.8432	0.7052	0.4913	0.3362	0.3660	0.6435	0.8674	0.9473	0.9716	(86)
MIT	19.3721	19.5620	19.9354	20.3926	20.7570	20.9491	20.9895	20.9863	20.8689	20.4326	19.8461	19.3418	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house	0.9611	0.9448	0.9048	0.8120	0.6468	0.4028	0.2290	0.2544	0.5594	0.8335	0.9355	0.9661	(89)
MIT 2	17.8246	18.0999	18.6321	19.2684	19.7372	19.9503	19.9784	19.9807	19.8791	19.3397	18.5191	17.7869	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3023	18.5513	19.0345	19.6155	20.0520	20.2586	20.2906	20.2912	20.1847	19.6771	18.9288	18.2669	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1523	18.4013	18.8845	19.4655	19.9020	20.1086	20.1406	20.1412	20.0347	19.5271	18.7788	18.1169	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Utilisation	0.9459	0.9271	0.8841	0.7939	0.6421	0.4142	0.2461	0.2720	0.5640	0.8154	0.9171	0.9522	(94)
Useful gains	778.3051	845.2805	888.8166	891.5517	757.1054	498.6913	280.8276	291.4626	553.3236	711.3495	740.0675	741.8048	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1679.8937	1639.4749	1470.8295	1216.5192	877.7837	518.0802	283.1050	294.6229	609.6368	1003.7457	1364.8219	1659.2392	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	670.7820	533.6987	433.0176	233.9766	89.7847	0.0000	0.0000	0.0000	0.0000	217.5428	449.8232	682.5712	(98)
Space heating												3311.1967	(98)
Space heating per m2											(98) / (4) =	29.4433	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3658.7808	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.7820	533.6987	433.0176	233.9766	89.7847	0.0000	0.0000	0.0000	0.0000	217.5428	449.8232	682.5712	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	741.1955	589.7223	478.4724	258.5377	99.2096	0.0000	0.0000	0.0000	0.0000	240.3788	497.0422	754.2223	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8050	89.7507	89.6003	89.2549	88.5290	87.3000	87.3000	87.3000	87.3000	89.1703	89.6334	89.8302	(217)
Fuel for water heating, kWh/month	199.9205	175.3962	182.3402	161.0598	156.9042	138.9421	130.3772	147.2980	148.3736	167.3190	179.7975	194.0411	(219)
Water heating fuel used												1981.7694	(219)
Annual totals kWh/year													
Space heating fuel - main system												3658.7808	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6176.1524	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3658.7808	3.9200	143.4242	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.7694	3.9200	77.6854	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Total energy cost			399.9477	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3658.7808	0.2160	790.2967	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.7694	0.2160	428.0622	(264)
Space and water heating			1218.3588	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1496.3364	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3658.7808	1.2200	4463.7126	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.7694	1.2200	2417.7587	(264)
Space and water heating			6881.4713	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Primary energy kWh/year			8525.7700	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 75.8116 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 31	-192 kg (12.8%)
U Solar photovoltaic panels	+ 8.5	-£ 309	-947 kg (72.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.71 kg/m²	B 86	B 88
Solar photovoltaic panels	£309	8.42 kg/m²	A 94	A 95
Total Savings	£340	10.12 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£91	£99	-£8
Mains gas	£309	£270	£40
Space heating	£244	£244	£0
Water heating	£78	£47	£31
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£400	£60	£341
Total cost of uses	£400	£60	£340
Delivered energy	55 kWh/m²	30 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	76 kWh/m²	16 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
										Solar input (sum of months) = Sum(63)m =		-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
										Total per year (kWh/year) = Sum(64)m =		886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Southwest	2.1600	36.7938	0.4600	0.0000	0.7700	28.1499	(79)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	138.5830	247.6845	369.9338	510.6554	619.8923	636.5363	604.8932	520.1345	418.1343	282.0983	168.1039	117.2327	(83)
Total gains	807.3453	911.0702	1006.8978	1106.7005	1173.7828	1153.1046	1100.0150	1024.8835	946.7796	851.8943	783.4914	767.3579	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9731	0.9594	0.9328	0.8743	0.7708	0.6197	0.4799	0.5270	0.7365	0.9004	0.9595	0.9768	(86)
MIT	19.1692	19.3922	19.7544	20.2230	20.6160	20.8678	20.9570	20.9413	20.7569	20.2522	19.6348	19.1313	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9680	0.9519	0.9199	0.8494	0.7246	0.5438	0.3793	0.4254	0.6692	0.8753	0.9506	0.9724	(89)
MIT 2	17.5164	17.8394	18.3598	19.0256	19.5516	19.8629	19.9492	19.9398	19.7437	19.0813	18.2020	17.4684	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.0267	18.3188	18.7904	19.3953	19.8802	20.1732	20.2603	20.2490	20.0565	19.4428	18.6444	17.9818	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8767	18.1688	18.6404	19.2453	19.7302	20.0232	20.1103	20.0990	19.9065	19.2928	18.4944	17.8318	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9541	0.9347	0.8993	0.8289	0.7130	0.5478	0.3934	0.4384	0.6646	0.8550	0.9337	0.9597	(94)
Useful gains	770.3027	851.5833	905.5234	917.3662	836.8635	631.6236	432.6960	449.2753	629.2255	728.3908	731.5250	736.4622	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1791.3005	1745.4975	1592.4086	1338.3672	1036.1608	691.2783	447.4543	470.4317	743.6458	1121.6602	1477.9988	1777.9232	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	759.6223	600.7103	511.0426	303.1207	148.2772	0.0000	0.0000	0.0000	0.0000	292.5924	537.4611	774.8470	(98)
Space heating												3927.6736	(98)
Space heating per m2											(98) / (4) =	34.9251	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4339.9708	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	759.6223	600.7103	511.0426	303.1207	148.2772	0.0000	0.0000	0.0000	0.0000	292.5924	537.4611	774.8470	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	839.3617	663.7683	564.6879	334.9400	163.8422	0.0000	0.0000	0.0000	0.0000	323.3066	593.8797	856.1845	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9439	89.9701	90.0008	90.0575	90.1199	87.3000	87.3000	87.3000	87.3000	89.6944	89.8545	89.9562	(217)
Fuel for water heating, kWh/month	171.3466	127.8159	101.2502	52.1030	21.3926	4.2204	0.0000	31.1465	57.4037	105.8779	145.7953	170.1196	(219)
Water heating fuel used												988.4717	(219)
Annual totals kWh/year													
Space heating fuel - main system												4339.9708	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4186.8054	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4339.9708	3.4800	151.0310	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.4717	3.4800	34.3988	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			154.8479	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4130	(257)
SAP value		94.2382	
SAP rating (Section 12)		94	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4339.9708	0.2160	937.4337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.4717	0.2160	213.5099	(264)
Space and water heating			1150.9436	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			558.4339	(272)
CO2 emissions per m2			4.9700	(273)
EI value			95.2477	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2007	(H8)
Utilisation factor												0.5652	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-894.4782	(H17)
Solar input	-27.5316	-41.3799	-69.6890	-96.3316	-116.0156	-122.1014	-119.1695	-106.4191	-83.0605	-56.5045	-33.4654	-22.8101	(63)
									Solar input (sum of months) = Sum(63)m =			-894.4782	(63)
Output from w/h	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
									Total per year (kWh/year) = Sum(64)m =			872.5734	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	5.8100	40.4699	0.4600	0.0000	0.7700	83.2831	(77)
Southwest	2.1600	40.4699	0.4600	0.0000	0.7700	30.9624	(79)
Northwest	2.1700	12.9236	0.4600	0.0000	0.7700	9.9332	(81)
Northwest	5.4600	12.9236	0.4600	0.0000	0.7700	24.9933	(81)
Northwest	0.6500	18.7850	0.6300	0.7000	1.0000	4.8463	(82)

Solar gains	154.0183	248.4091	368.4021	526.9910	625.1329	687.5292	646.0844	566.9650	452.4234	302.6271	191.5407	128.9481	(83)
Total gains	822.7806	911.7948	1005.3661	1123.0361	1179.0234	1204.0974	1141.2061	1071.7140	981.0686	872.4232	806.9282	779.0732	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9674	0.9536	0.9204	0.8432	0.7052	0.4913	0.3362	0.3660	0.6435	0.8674	0.9473	0.9716	(86)
MIT	19.3721	19.5620	19.9354	20.3926	20.7570	20.9491	20.9895	20.9863	20.8689	20.4326	19.8461	19.3418	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house	0.9611	0.9448	0.9048	0.8120	0.6468	0.4028	0.2290	0.2544	0.5594	0.8335	0.9355	0.9661	(89)
MIT 2	17.8246	18.0999	18.6321	19.2684	19.7372	19.9503	19.9784	19.9807	19.8791	19.3397	18.5191	17.7869	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.3023	18.5513	19.0345	19.6155	20.0520	20.2586	20.2906	20.2912	20.1847	19.6771	18.9288	18.2669	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1523	18.4013	18.8845	19.4655	19.9020	20.1086	20.1406	20.1412	20.0347	19.5271	18.7788	18.1169	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9459	0.9271	0.8841	0.7939	0.6421	0.4142	0.2461	0.2720	0.5640	0.8154	0.9171	0.9522	(94)
Useful gains	778.3051	845.2805	888.8166	891.5517	757.1054	498.6913	280.8276	291.4626	553.3236	711.3495	740.0675	741.8048	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1679.8937	1639.4749	1470.8295	1216.5192	877.7837	518.0802	283.1050	294.6229	609.6368	1003.7457	1364.8219	1659.2392	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	670.7820	533.6987	433.0176	233.9766	89.7847	0.0000	0.0000	0.0000	0.0000	217.5428	449.8232	682.5712	(98)
Space heating												3311.1967	(98)
Space heating per m2											(98) / (4) =	29.4433	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3658.7808	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.7820	533.6987	433.0176	233.9766	89.7847	0.0000	0.0000	0.0000	0.0000	217.5428	449.8232	682.5712	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	741.1955	589.7223	478.4724	258.5377	99.2096	0.0000	0.0000	0.0000	0.0000	240.3788	497.0422	754.2223	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8913	89.9114	89.9138	89.9444	89.8311	87.3000	87.3000	87.3000	87.3000	89.5196	89.7724	89.9014	(217)
Fuel for water heating, kWh/month	169.1009	129.0596	104.1979	52.7239	25.4812	0.0000	0.0000	25.3976	53.2299	103.5464	142.2410	168.5150	(219)
Water heating fuel used												973.4934	(219)
Annual totals kWh/year													
Space heating fuel - main system												3658.7808	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3393.7168	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3658.7808	3.9200	143.4242	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.4934	3.9200	38.1609	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			59.5258	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3658.7808	0.2160	790.2967	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.4934	0.2160	210.2746	(264)
Space and water heating			1000.5712	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			357.7599	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3658.7808	1.2200	4463.7126	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.4934	1.2200	1187.6619	(264)
Space and water heating			5651.3746	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1849.0032	(272)
Primary energy kWh/m2/year			16.4414	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		384.18 (P1)
Transmission heat loss coefficient		73.87 (37)
Summer heat loss coefficient		458.04 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	1.00	1.000	1.000	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	5.8100	119.9223	0.4600	0.0000	0.9000	288.4540
South West	2.1600	119.9223	0.4600	0.0000	0.9000	107.2394
North West	2.1700	98.8453	0.4600	0.0000	0.9000	88.8006
North West	5.4600	98.8453	0.4600	0.0000	0.9000	223.4338
North West	0.6500	156.6480	0.6300	0.7000	1.0000	40.4128
total:						748.3406

	Jun	Jul	Aug	
Solar gains	796	748	657	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1310	1240	1159	(P5)
Summer gain/loss ratio	2.86	2.71	2.53	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.90	21.65	21.37	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-320	**Issued on Date**	19/10/2022
Assessment Reference	Plot 320	**Prop Type Ref**	Ebbertson-Opp-SEMI
Property	Plot 320, 3 Bed, K, WC, B, Es		

SAP Rating	85 B	**DER**	16.23	**TER**	17.50
Environmental	86 B	**% DER<TER**	7.28		
CO_2 Emissions (t/year)	1.51	**DFEE**	47.91	**TFEE**	55.43
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.57		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 112 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.50 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.23 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.9 kWh/m²/yrOK
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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 2.16 m², No overhang
Windows facing South East: 5.81 m², No overhang
Windows facing North West: 7.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	448.2253	445.8171	429.4268	402.9144	375.6812	349.7969	333.2404	339.8993	353.7641	380.5084	411.1785	434.4781	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	567.2907	663.1231	765.4114	884.2708	974.4079	970.4461	920.6838	835.7323	739.4355	631.0854	556.4269	534.6699	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9898	0.9825	0.9660	0.9233	0.8350	0.6940	0.5547	0.6153	0.8264	0.9509	0.9838	0.9915	(86)
MIT	18.8798	19.1045	19.4959	20.0266	20.4974	20.8141	20.9344	20.9075	20.6445	20.0350	19.3695	18.8470	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9877	0.9790	0.9587	0.9058	0.7956	0.6187	0.4450	0.5068	0.7696	0.9365	0.9799	0.9898	(89)
MIT 2	17.0980	17.4266	17.9952	18.7610	19.4081	19.8119	19.9348	19.9160	19.6206	18.7867	17.8224	17.0566	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.6481	17.9446	18.4585	19.1517	19.7444	20.1213	20.2434	20.2221	19.9367	19.1721	18.3001	17.6093	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4981	17.7946	18.3085	19.0017	19.5944	19.9713	20.0934	20.0721	19.7867	19.0221	18.1501	17.4593	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9804	0.9683	0.9430	0.8853	0.7791	0.6185	0.4587	0.5180	0.7576	0.9185	0.9698	0.9835	(94)
Useful gains	556.1524	642.0936	721.7867	782.8605	759.1783	600.2300	422.3450	432.9000	560.1874	579.6400	539.6062	525.8360	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1741.3521	1696.2719	1548.8825	1306.8539	1018.6380	684.6694	445.2972	467.0118	728.2999	1086.7308	1433.3412	1729.3386	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	881.7886	708.4078	615.3593	377.2753	193.0380	0.0000	0.0000	0.0000	0.0000	377.2756	643.4892	895.4060	(98)

Space heating 4692.0398 (98)
Space heating per m2 (98) / (4) = 41.7219 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5184.5743 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	881.7886	708.4078	615.3593	377.2753	193.0380	0.0000	0.0000	0.0000	0.0000	377.2756	643.4892	895.4060	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	974.3520	782.7711	679.9550	416.8788	213.3017	0.0000	0.0000	0.0000	0.0000	416.8791	711.0378	989.3989	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9423	89.9009	89.8093	89.5939	89.1328	87.3000	87.3000	87.3000	87.3000	89.5696	89.8404	89.9627	(217)
Fuel for water heating, kWh/month	199.6152	175.1031	181.9157	160.4504	155.8412	138.9421	130.3772	147.2980	148.3736	166.5731	179.3831	193.7554	(219)
Water heating fuel used												1977.6282	(219)
Annual totals kWh/year													
Space heating fuel - main system												5184.5743	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												7697.8047	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5184.5743	0.2160	1119.8681	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.6282	0.2160	427.1677	(264)
Space and water heating			1547.0357	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/year			1825.0133	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.2300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.2300	ZC1
Total Floor Area	TFA	112.4600	
Assumed number of occupants	N	2.8288	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4927	ZC2
CO2 emissions from cooking, equation (L16)		1.6618	ZC3
Total CO2 emissions		32.3846	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.3846	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9978	48.5645	44.9980	46.4979	48.5645	48.9978	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.9685	(64)
Heat gains from water heating, kWh/month													
	67.7302	59.6019	62.3695	55.5179	53.6582	47.0756	44.8226	50.2365	50.7998	57.6664	61.3698	65.9951	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	91.0353	88.6933	83.8300	77.1082	72.1213	65.3828	60.2455	67.5222	70.5553	77.5087	85.2358	88.7031	(72)
Total internal gains													
	460.5927	458.1887	441.8072	415.1973	387.2814	360.7168	344.1687	351.5074	366.0587	392.9002	423.5564	446.8497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(75)
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	103.3119	188.6894	292.0949	419.0382	521.6809	540.9740	511.9541	431.8184	335.4767	217.6728	126.0548	86.9202	(83)
Total gains	563.9046	646.8781	733.9021	834.2355	908.9623	901.6908	856.1228	783.3258	701.5354	610.5730	549.6111	533.7699	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9991	0.9981	0.9944	0.9785	0.9204	0.7761	0.6079	0.6772	0.9080	0.9891	0.9982	0.9994	(86)
MIT	19.6948	19.8321	20.0767	20.4200	20.7328	20.9288	20.9843	20.9732	20.8208	20.4219	20.0027	19.6771	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9988	0.9974	0.9923	0.9696	0.8860	0.6897	0.4820	0.5511	0.8540	0.9832	0.9975	0.9991	(89)
MIT 2	18.2248	18.4276	18.7864	19.2912	19.7216	19.9591	20.0034	19.9997	19.8472	19.3003	18.6869	18.2066	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	18.6787	18.8612	19.1847	19.6397	20.0338	20.2585	20.3062	20.3002	20.1478	19.6466	19.0931	18.6606	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6787	18.8612	19.1847	19.6397	20.0338	20.2585	20.3062	20.3002	20.1478	19.6466	19.0931	18.6606	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9963	0.9900	0.9655	0.8875	0.7134	0.5212	0.5902	0.8634	0.9803	0.9964	0.9987	(94)
Useful gains	562.9303	644.4677	726.5415	805.4136	806.6710	643.2348	446.2508	462.3506	605.6710	598.5273	547.6520	533.0782	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1825.6037	1767.1633	1600.7519	1336.0450	1033.9554	693.1953	454.0330	476.6742	744.5293	1122.3851	1496.0887	1814.1544	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	939.4290	754.4514	650.4125	382.0546	169.0996	0.0000	0.0000	0.0000	0.0000	389.7502	682.8744	953.1207	(98)
Space heating												4921.1924	(98)
Space heating per m2											(98) / (4) =	43.7595	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5268.9427	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	939.4290	754.4514	650.4125	382.0546	169.0996	0.0000	0.0000	0.0000	0.0000	389.7502	682.8744	953.1207	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1005.8127	807.7638	696.3731	409.0520	181.0488	0.0000	0.0000	0.0000	0.0000	417.2914	731.1289	1020.4718	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.3439	190.6742	200.2214	179.1285	173.4280	152.7457	146.3420	163.1370	164.9387	186.0769	196.8069	211.1255	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3206	88.1629	87.8006	86.9107	84.9877	80.3000	80.3000	80.3000	80.3000	86.8692	87.9258	88.3841	(217)
Fuel for water heating, kWh/month													
	244.9530	216.2750	228.0410	206.1064	204.0625	190.2188	182.2441	203.1594	205.4031	214.2035	223.8329	238.8728	(219)
Water heating fuel used												2557.3724	(219)
Annual totals kWh/year													
Space heating fuel - main system												5268.9427	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												8361.9173	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5268.9427	0.2160	1138.0916	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2557.3724	0.2160	552.3924	(264)
Space and water heating			1690.4841	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total CO2, kg/m2/year			1968.4616	(272)
Emissions per m2 for space and water heating			15.0319	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1257	(272b)
Emissions per m2 for pumps and fans			0.3461	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0319 * 1.00) + 2.1257 + 0.3461, rounded to 2 d.p.			17.5000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			9.0000	257.7600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15142.1290 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.6446 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278 (36)
Total fabric heat loss	(33) + (36) =	73.8650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	532.8598	629.5417	733.5939	854.8521	946.5502	944.7837	896.8839	809.5423	712.3935	601.5607	524.0996	501.0849	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8794	31.9740	32.0673	32.5127	32.5974	32.9977	32.9977	33.0729	32.8424	32.5974	32.4265	32.2497	
alpha	3.1253	3.1316	3.1378	3.1675	3.1732	3.1998	3.1998	3.2049	3.1895	3.1732	3.1618	3.1500	
util living area	0.9910	0.9842	0.9685	0.9274	0.8417	0.7033	0.5647	0.6276	0.8360	0.9552	0.9857	0.9926	(86)
MIT	18.8121	19.0412	19.4410	19.9844	20.4694	20.8001	20.9282	20.8983	20.6200	19.9904	19.3104	18.7795	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9892	0.9810	0.9617	0.9108	0.8035	0.6288	0.4546	0.5192	0.7813	0.9419	0.9822	0.9911	(89)
MIT 2	17.9347	18.1644	18.5623	19.1026	19.5603	19.8536	19.9441	19.9302	19.7120	19.1184	18.4431	17.9100	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2056	18.4351	18.8335	19.3748	19.8410	20.1458	20.2479	20.2291	19.9923	19.3876	18.7109	18.1784	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2056	18.4351	18.8335	19.3748	19.8410	20.1458	20.2479	20.2291	19.9923	19.3876	18.7109	18.1784	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9850	0.9747	0.9525	0.8995	0.7984	0.6425	0.4859	0.5482	0.7828	0.9324	0.9765	0.9875	(94)
Useful gains	524.8774	613.6376	698.7472	768.9142	755.6996	607.0082	435.7783	443.8227	557.6294	560.8868	511.8081	494.8398	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1834.6938	1780.5349	1617.7466	1355.1220	1050.4558	706.9141	464.9953	486.9739	754.6343	1133.8962	1506.0868	1823.1288	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

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	974.5034	784.1550	683.7356	422.0696	219.2987	0.0000	0.0000	0.0000	0.0000	426.3190	715.8807	988.2470 (98)
Space heating												5214.2089 (98)
Space heating per m2											(98) / (4) =	46.3650 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1198.1975	943.2619	966.5525	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7655	0.8317	0.7938	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	917.2168	784.4939	767.2475	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1209.6178	1151.6762	1053.1801	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	210.5287	273.1836	212.7339	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												696.4462	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	52.6322	68.2959	53.1835	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												174.1116	(107)
Space cooling per m2												1.5482	(108)
Energy for space heating												46.3650	(99)
Energy for space cooling												1.5482	(108)
Total												47.9132	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1374	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3874	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3584	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4569	0.4480	0.4390	0.3942	0.3853	0.3405	0.3405	0.3315	0.3584	0.3853	0.4032	0.4211	(22b)
Effective ac	0.6044	0.6003	0.5964	0.5777	0.5742	0.5580	0.5580	0.5549	0.5642	0.5742	0.5813	0.5887	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.6000	1.3258	20.6818			(27)
TER Room Window (Uw = 1.70)			0.6500	1.5918	1.0346			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1300	5.7252			(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.1800	13.5792			(29a)
Wall to Void	12.9100		12.9100	0.1800	2.3238			(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.1800	0.8100			(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.1800	2.9970			(29a)
Plane Ceiling	17.2000		17.2000	0.1300	2.2360			(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.1300	0.3185			(30)
Sloping	13.3300	0.6500	12.6800	0.1300	1.6484			(30)
Ceiling to void	11.1400		11.1400	0.1300	1.4482			(30)
Plane	4.9800		4.9800	0.1300	0.6474			(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.5802			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3375	(36)
Total fabric heat loss (33) + (36) =	68.9177	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0485	57.6591	57.2775	55.4850	55.1496	53.5884	53.5884	53.2993	54.1898	55.1496	55.8281	56.5374	(38)
Heat transfer coeff	126.9661	126.5768	126.1952	124.4027	124.0673	122.5061	122.5061	122.2170	123.1074	124.0673	124.7457	125.4550	(39)
Average = Sum(39)m / 12 =												124.4010	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1255	1.1221	1.1062	1.1032	1.0893	1.0893	1.0868	1.0947	1.1032	1.1092	1.1156	(40)
HLP (average)												1.1062	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8288	(42)
Average daily hot water use (litres/day)	101.3843	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1443	30.7374	31.7183	27.6528	26.5335	22.8964	21.2169	24.3467	24.6374	28.7126	31.3420	34.0354	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	141.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.0812	23.1651	18.8391	14.2624	10.6613	9.0007	9.7256	12.6417	16.9677	21.5444	25.1455	26.8061	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	275.0440	277.8981	270.7059	255.3945	236.0666	217.9011	205.7654	202.9113	210.1035	225.4150	244.7429	262.9084	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	37.1441	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	47.2370	45.7402	42.6321	38.4066	35.6633	31.8005	28.5173	32.7240	34.2187	38.5922	43.5306	45.7465	(72)
Total internal gains													
	413.7944	412.2357	397.6093	373.4957	347.8234	324.1346	309.4405	313.7093	326.7221	350.9837	378.8511	400.8931	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(75)
Southeast	5.8100	36.7938	0.6300	0.7000	0.7700	65.3316	(77)
Northwest	7.6300	11.2829	0.6300	0.7000	0.7700	26.3099	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	103.3119	188.6894	292.0949	419.0382	521.6809	540.9740	511.9541	431.8184	335.4767	217.6728	126.0548	86.9202	(83)
Total gains	517.1063	600.9250	689.7043	792.5339	869.5044	865.1085	821.3946	745.5277	662.1988	568.6565	504.9059	487.8133	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.5103	61.6995	61.8861	62.7778	62.9475	63.7497	63.7497	63.9005	63.4383	62.9475	62.6051	62.2512	
alpha	5.1007	5.1133	5.1257	5.1852	5.1965	5.2500	5.2500	5.2600	5.2292	5.1965	5.1737	5.1501	
util living area													
	0.9994	0.9986	0.9958	0.9827	0.9315	0.7960	0.6296	0.7034	0.9239	0.9920	0.9988	0.9996	(86)
MIT	19.6557	19.7939	20.0406	20.3884	20.7103	20.9194	20.9815	20.9681	20.7995	20.3884	19.9654	19.6386	(87)
Th 2	19.9772	19.9800	19.9828	19.9958	19.9982	20.0096	20.0096	20.0117	20.0052	19.9982	19.9933	19.9882	(88)
util rest of house													
	0.9992	0.9981	0.9942	0.9752	0.9004	0.7115	0.5012	0.5761	0.8759	0.9876	0.9983	0.9994	(89)
MIT 2	18.7417	18.8820	19.1302	19.4844	19.7905	19.9697	20.0045	20.0016	19.8812	19.4891	19.0642	18.7333	(90)
Living area fraction										fLA = Living area / (4) =		0.3087	(91)
MIT	19.0239	19.1635	19.4113	19.7635	20.0745	20.2629	20.3061	20.3000	20.1647	19.7667	19.3424	19.0128	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0239	19.1635	19.4113	19.7635	20.0745	20.2629	20.3061	20.3000	20.1647	19.7667	19.3424	19.0128	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9976	0.9929	0.9730	0.9032	0.7353	0.5415	0.6160	0.8853	0.9862	0.9978	0.9992	(94)
Useful gains	516.5739	599.4775	684.8270	771.1525	785.3796	636.1158	444.7628	459.2411	586.2518	560.7948	503.8032	487.4464	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1869.4403	1805.4340	1629.3377	1351.4500	1038.9998	693.7421	454.0252	476.6463	746.6150	1137.2930	1527.1874	1858.3409	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1006.5326	810.4028	702.7160	417.8142	188.6934	0.0000	0.0000	0.0000	0.0000	428.9146	736.8366	1019.9455	(98)
Space heating												5311.8557	(98)
Space heating per m2											(98) / (4) =	47.2333	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1151.5571	906.5450	928.8489	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8267	0.8989	0.8612	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	952.0296	814.8950	799.9667	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1116.4910	1063.4419	978.3578	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	118.4122	184.9189	132.7230	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												436.0541	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	29.6030	46.2297	33.1807	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												109.0135	(107)
Space cooling per m2												0.9694	(108)
Energy for space heating												47.2333	(99)
Energy for space cooling												0.9694	(108)
Total												48.2026	(109)
Target Fabric Energy Efficiency (TFEE)												55.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)
Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
RHI water heating demand												1761	(64)
Heat gains from water heating, kWh/month													
	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)													
	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains													
	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	12.9236	0.4600	0.0000	0.7700	9.8875	(75)
Southeast	5.8100	40.4699	0.4600	0.0000	0.7700	83.2831	(77)
Northwest	2.1700	12.9236	0.4600	0.0000	0.7700	9.9332	(81)
Northwest	5.4600	12.9236	0.4600	0.0000	0.7700	24.9933	(81)
Northwest	0.6500	18.7850	0.6300	0.7000	1.0000	4.8463	(82)

Solar gains	132.9433	219.1703	336.6935	499.5410	606.4312	672.8544	629.9589	543.2444	419.8735	270.4261	166.3210	110.6827	(83)
Total gains	801.7056	882.5560	973.6575	1095.5861	1160.3218	1189.4226	1125.0806	1047.9934	948.5187	840.2221	781.7085	760.8078	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area													
	0.9695	0.9573	0.9262	0.8506	0.7118	0.4964	0.3408	0.3737	0.6582	0.8774	0.9513	0.9734	(86)
MIT	19.3478	19.5299	19.9047	20.3730	20.7498	20.9475	20.9891	20.9855	20.8597	20.4070	19.8190	19.3203	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house													
	0.9636	0.9491	0.9114	0.8203	0.6537	0.4073	0.2322	0.2600	0.5740	0.8452	0.9403	0.9682	(89)
MIT 2	17.7898	18.0544	18.5897	19.2431	19.7294	19.9492	19.9782	19.9804	19.8709	19.3070	18.4811	17.7561	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2708	18.5099	18.9957	19.5920	20.0444	20.2574	20.2903	20.2907	20.1761	19.6466	18.8941	18.2391	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1208	18.3599	18.8457	19.4420	19.8944	20.1074	20.1403	20.1407	20.0261	19.4966	18.7441	18.0891	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9490	0.9320	0.8910	0.8018	0.6486	0.4186	0.2495	0.2779	0.5779	0.8265	0.9225	0.9547	(94)
Useful gains	760.8309	822.5107	867.5067	878.3963	752.5962	497.9237	280.7027	291.1927	548.1556	694.4742	721.1056	726.3552	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1675.8372	1634.1760	1465.8534	1213.5272	876.8196	517.9242	283.0762	294.5622	608.5567	999.8832	1360.4347	1655.6862	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	680.7646	545.4391	445.1700	241.2943	92.4223	0.0000	0.0000	0.0000	0.0000	227.2243	460.3169	691.4223	(98)
Space heating												3384.0538	(98)
RHI space heating demand												3384	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	787.8277	880.6917	972.9486	1077.4015	1152.6173	1137.2174	1082.5651	1000.5821	914.3166	820.3730	760.6359	750.3170	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area	0.9748	0.9628	0.9380	0.8811	0.7776	0.6258	0.4864	0.5372	0.7502	0.9084	0.9624	0.9781	(86)
MIT	19.1464	19.3584	19.7201	20.1993	20.6049	20.8640	20.9552	20.9379	20.7422	20.2238	19.6093	19.1111	(87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523	(88)
util rest of house	0.9700	0.9558	0.9260	0.8571	0.7319	0.5498	0.3849	0.4346	0.6841	0.8848	0.9542	0.9740	(89)
MIT 2	17.4836	17.7912	18.3119	18.9942	19.5385	19.8593	19.9481	19.9375	19.7282	19.0436	18.1658	17.4393	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	17.9970	18.2750	18.7466	19.3662	19.8677	20.1695	20.2591	20.2464	20.0412	19.4080	18.6114	17.9554	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8470	18.1250	18.5966	19.2162	19.7177	20.0195	20.1091	20.0964	19.8912	19.2580	18.4614	17.8054	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9566	0.9393	0.9059	0.8365	0.7198	0.5534	0.3990	0.4474	0.6784	0.8645	0.9378	0.9618	(94)
Useful gains	753.6441	827.2408	881.3721	901.2147	829.6263	629.3753	431.9181	447.6653	620.2585	709.1939	713.3153	721.6551	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1787.3816	1739.7378	1586.6713	1334.6051	1034.5508	690.8110	447.2928	470.0980	741.6884	1117.1636	1473.7293	1774.4779	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	769.1006	613.1980	524.7426	312.0410	152.4638	0.0000	0.0000	0.0000	0.0000	303.5295	547.4981	783.3001	(98)
Space heating												4005.8737	(98)
Space heating per m2											(98) / (4) =	35.6204	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4426.3798	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	769.1006	613.1980	524.7426	312.0410	152.4638	0.0000	0.0000	0.0000	0.0000	303.5295	547.4981	783.3001	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	849.8350	677.5668	579.8260	344.7967	168.4683	0.0000	0.0000	0.0000	0.0000	335.3917	604.9702	865.5250	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8765	89.8274	89.7192	89.4657	88.9457	87.3000	87.3000	87.3000	87.3000	89.4198	89.7518	89.9002	(217)
Fuel for water heating, kWh/month	199.7613	175.2463	182.0985	160.6803	156.1691	138.9421	130.3772	147.2980	148.3736	166.8520	179.5602	193.8901	(219)
Water heating fuel used												1979.2489	(219)
Annual totals kWh/year													
Space heating fuel - main system												4426.3798	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6941.2309	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4426.3798	3.4800	154.0380	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.2489	3.4800	68.8779	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Total energy cost			413.5618	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1031	(257)
SAP value		84.6116	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4426.3798	0.2160	956.0980	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.2489	0.2160	427.5178	(264)
Space and water heating			1383.6158	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1661.5933	(272)
CO2 emissions per m2			14.7700	(273)
EI value			85.8597	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8884 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8884 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1374	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3879	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1278	(36)
Total fabric heat loss	(33) + (36) =	73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.8965	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	12.9236	0.4600	0.0000	0.7700	9.8875	(75)
Southeast	5.8100	40.4699	0.4600	0.0000	0.7700	83.2831	(77)
Northwest	2.1700	12.9236	0.4600	0.0000	0.7700	9.9332	(81)
Northwest	5.4600	12.9236	0.4600	0.0000	0.7700	24.9933	(81)
Northwest	0.6500	18.7850	0.6300	0.7000	1.0000	4.8463	(82)

Solar gains	132.9433	219.1703	336.6935	499.5410	606.4312	672.8544	629.9589	543.2444	419.8735	270.4261	166.3210	110.6827	(83)
Total gains	801.7056	882.5560	973.6575	1095.5861	1160.3218	1189.4226	1125.0806	1047.9934	948.5187	840.2221	781.7085	760.8078	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594	
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373	
util living area	0.9695	0.9573	0.9262	0.8506	0.7118	0.4964	0.3408	0.3737	0.6582	0.8774	0.9513	0.9734	(86)
MIT	19.3478	19.5299	19.9047	20.3730	20.7498	20.9475	20.9891	20.9855	20.8597	20.4070	19.8190	19.3203	(87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736	(88)
util rest of house	0.9636	0.9491	0.9114	0.8203	0.6537	0.4073	0.2322	0.2600	0.5740	0.8452	0.9403	0.9682	(89)
MIT 2	17.7898	18.0544	18.5897	19.2431	19.7294	19.9492	19.9782	19.9804	19.8709	19.3070	18.4811	17.7561	(90)
Living area fraction									fLA = Living area / (4) =			0.3087	(91)
MIT	18.2708	18.5099	18.9957	19.5920	20.0444	20.2574	20.2903	20.2907	20.1761	19.6466	18.8941	18.2391	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1208	18.3599	18.8457	19.4420	19.8944	20.1074	20.1403	20.1407	20.0261	19.4966	18.7441	18.0891	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Utilisation	0.9490	0.9320	0.8910	0.8018	0.6486	0.4186	0.2495	0.2779	0.5779	0.8265	0.9225	0.9547	(94)
Useful gains	760.8309	822.5107	867.5067	878.3963	752.5962	497.9237	280.7027	291.1927	548.1556	694.4742	721.1056	726.3552	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1675.8372	1634.1760	1465.8534	1213.5272	876.8196	517.9242	283.0762	294.5622	608.5567	999.8832	1360.4347	1655.6862	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	680.7646	545.4391	445.1700	241.2943	92.4223	0.0000	0.0000	0.0000	0.0000	227.2243	460.3169	691.4223	(98)
Space heating												3384.0538	(98)
Space heating per m2											(98) / (4) =	30.0912	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3739.2859	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	680.7646	545.4391	445.1700	241.2943	92.4223	0.0000	0.0000	0.0000	0.0000	227.2243	460.3169	691.4223	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	752.2261	602.6951	491.9005	266.6235	102.1240	0.0000	0.0000	0.0000	0.0000	251.0766	508.6375	764.0026	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8130	89.7631	89.6181	89.2782	88.5510	87.3000	87.3000	87.3000	87.3000	89.2040	89.6479	89.8370	(217)
Fuel for water heating, kWh/month	199.9027	175.3719	182.3040	161.0177	156.8652	138.9421	130.3772	147.2980	148.3736	167.2557	179.7684	194.0265	(219)
Water heating fuel used												1981.5031	(219)
Annual totals kWh/year													
Space heating fuel - main system												3739.2859	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Total delivered energy for all uses												6256.3912	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3739.2859	3.9200	146.5800	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.5031	3.9200	77.6749	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Total energy cost			403.0931	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3739.2859	0.2160	807.6858	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.5031	0.2160	428.0047	(264)
Space and water heating			1235.6904	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Total kg/year			1513.6680	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3739.2859	1.2200	4561.9289	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.5031	1.2200	2417.4337	(264)
Space and water heating			6979.3626	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Primary energy kWh/year			8623.6614	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 76.6820 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 31	-192 kg (12.7%)
U Solar photovoltaic panels	+ 8.5	-£ 309	-947 kg (71.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.71 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	8.42 kg/m²	A 94	A 95
Total Savings	£340	10.12 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£91	£99	-£8
Mains gas	£312	£273	£40
Space heating	£247	£247	£0
Water heating	£78	£47	£31
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£403	£63	£341
Total cost of uses	£403	£63	£340
Delivered energy	56 kWh/m²	31 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	17 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4575	0.4486	0.4396	0.3947	0.3858	0.3409	0.3409	0.3319	0.3588	0.3858	0.4037	0.4216	(22b)
Effective ac	0.6047	0.6006	0.5966	0.5779	0.5744	0.5581	0.5581	0.5551	0.5644	0.5744	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	58.0744	57.6840	57.3014	55.5043	55.1680	53.6028	53.6028	53.3129	54.2057	55.1680	55.8482	56.5594	(38)
Heat transfer coeff	131.9394	131.5490	131.1664	129.3693	129.0331	127.4678	127.4678	127.1780	128.0707	129.0331	129.7133	130.4244	(39)
Average = Sum(39)m / 12 =												129.3677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1732	1.1697	1.1663	1.1504	1.1474	1.1335	1.1335	1.1309	1.1388	1.1474	1.1534	1.1597	(40)
HLP (average)												1.1503	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8288	(42)
Average daily hot water use (litres/day)												101.3843	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1369	(H8)
Utilisation factor												0.5850	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3843	(H14)
Volume ratio Veff/V												0.7398	(H15)
Solar storage volume factor												0.9397	(H16)
Solar input												-876.7033	(H17)
Solar input	-25.4227	-42.4231	-72.2514	-96.8311	-119.6267	-117.6121	-116.0578	-101.4003	-79.4167	-54.2323	-30.1549	-21.2744	(63)
									Solar input (sum of months) = Sum(63)m =			-876.7033	(63)
Output from w/h	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
									Total per year (kWh/year) = Sum(64)m =			886.4316	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(75)
Southeast	5.8100	36.7938	0.4600	0.0000	0.7700	75.7181	(77)
Northwest	2.1700	11.2829	0.4600	0.0000	0.7700	8.6722	(81)
Northwest	5.4600	11.2829	0.4600	0.0000	0.7700	21.8204	(81)
Northwest	0.6500	16.3666	0.6300	0.7000	1.0000	4.2223	(82)

Solar gains	119.0654	217.3060	335.9846	481.3563	598.7268	620.6492	587.4434	495.8331	385.6714	250.5770	145.2484	100.1918	(83)
Total gains	787.8277	880.6917	972.9486	1077.4015	1152.6173	1137.2174	1082.5651	1000.5821	914.3166	820.3730	760.6359	750.3170	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4221	32.5183	32.6131	33.0662	33.1523	33.5594	33.5594	33.6359	33.4014	33.1523	32.9785	32.7987	
alpha	3.1615	3.1679	3.1742	3.2044	3.2102	3.2373	3.2373	3.2424	3.2268	3.2102	3.1986	3.1866	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9748	0.9628	0.9380	0.8811	0.7776	0.6258	0.4864	0.5372	0.7502	0.9084	0.9624	0.9781 (86)
MIT	19.1464	19.3584	19.7201	20.1993	20.6049	20.8640	20.9552	20.9379	20.7422	20.2238	19.6093	19.1111 (87)
Th 2	19.9415	19.9443	19.9470	19.9599	19.9623	19.9736	19.9736	19.9757	19.9693	19.9623	19.9574	19.9523 (88)
util rest of house	0.9700	0.9558	0.9260	0.8571	0.7319	0.5498	0.3849	0.4346	0.6841	0.8848	0.9542	0.9740 (89)
MIT 2	17.4836	17.7912	18.3119	18.9942	19.5385	19.8593	19.9481	19.9375	19.7282	19.0436	18.1658	17.4393 (90)
Living area fraction									fLA = Living area / (4) =			0.3087 (91)
MIT	17.9970	18.2750	18.7466	19.3662	19.8677	20.1695	20.2591	20.2464	20.0412	19.4080	18.6114	17.9554 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8470	18.1250	18.5966	19.2162	19.7177	20.0195	20.1091	20.0964	19.8912	19.2580	18.4614	17.8054 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9566	0.9393	0.9059	0.8365	0.7198	0.5534	0.3990	0.4474	0.6784	0.8645	0.9378	0.9618	(94)
Useful gains	753.6441	827.2408	881.3721	901.2147	829.6263	629.3753	431.9181	447.6653	620.2585	709.1939	713.3153	721.6551	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1787.3816	1739.7378	1586.6713	1334.6051	1034.5508	690.8110	447.2928	470.0980	741.6884	1117.1636	1473.7293	1774.4779	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	769.1006	613.1980	524.7426	312.0410	152.4638	0.0000	0.0000	0.0000	0.0000	303.5295	547.4981	783.3001	(98)
Space heating												4005.8737	(98)
Space heating per m2											(98) / (4) =	35.6204	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4426.3798	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	769.1006	613.1980	524.7426	312.0410	152.4638	0.0000	0.0000	0.0000	0.0000	303.5295	547.4981	783.3001	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	849.8350	677.5668	579.8260	344.7967	168.4683	0.0000	0.0000	0.0000	0.0000	335.3917	604.9702	865.5250	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.1158	114.9961	91.1259	46.9227	19.2790	3.6844	0.0000	27.1909	50.1134	94.9665	131.0037	153.0331	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9496	89.9791	90.0118	90.0684	90.1291	87.3000	87.3000	87.3000	87.3000	89.7163	89.8640	89.9611	(217)
Fuel for water heating, kWh/month	171.3358	127.8031	101.2378	52.0967	21.3904	4.2204	0.0000	31.1465	57.4037	105.8520	145.7799	170.1104	(219)
Water heating fuel used												988.3767	(219)
Annual totals kWh/year													
Space heating fuel - main system												4426.3798	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4273.1193	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4426.3798	3.4800	154.0380	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.3767	3.4800	34.3955	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	460.6022	13.1900	60.7534	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			157.8516	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4210	(257)
SAP value		94.1264	
SAP rating (Section 12)		94	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4426.3798	0.2160	956.0980	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.3767	0.2160	213.4894	(264)
Space and water heating			1169.5874	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			577.0777	(272)
CO2 emissions per m2			5.1300	(273)
EI value			95.0890	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.0400 (1b)	x	2.5400 (2b)	=	111.8616	(1b) - (3b)
First floor	39.7800 (1c)	x	2.6900 (2c)	=	107.0082	(1c) - (3c)
Second floor	28.6400 (1d)	x	2.5200 (2d)	=	72.1728	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	291.0426	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1374	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3879	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3588	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3768	0.3588	0.3588	0.3319	0.3319	0.2960	0.3050	0.2871	0.2960	0.3140	0.3140	0.3409	(22b)
Effective ac	0.5710	0.5644	0.5644	0.5551	0.5551	0.5438	0.5465	0.5412	0.5438	0.5493	0.5493	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1400	1.2357	12.5304			(27)
French Door (Uw = 1.30)			5.4600	1.2357	6.7471			(27)
Roof Window (Uw = 1.80)			0.6500	1.6791	1.0914			(27a)
GF B&B J150 P/A=0.40			44.0400	0.1200	5.2848	75.0000	3303.0000	(28a)
EW Brick AAC015	88.6700	13.2300	75.4400	0.2500	18.8600	52.1000	3930.4240	(29a)
Wall to Void	12.9100		12.9100	0.0800	1.0328	9.0000	116.1900	(29a)
DW GRP PU025	6.0000	1.5000	4.5000	0.4400	1.9800	9.0000	40.5000	(29a)
EW WBoard AAC015	19.6500	3.0000	16.6500	0.2400	3.9960	52.1000	867.4650	(29a)
Plane Ceiling	17.2000		17.2000	0.1600	2.7520	9.0000	154.8000	(30)
PR 400mm MW044 Dormer	2.4500		2.4500	0.2900	0.7105	9.0000	22.0500	(30)
Sloping	13.3300	0.6500	12.6800	0.1100	1.3948	9.0000	114.1200	(30)
Ceiling to void	11.1400		11.1400	0.0800	0.8912	9.0000	100.2600	(30)
Plane	4.9800		4.9800	0.1400	0.6972	9.0000	44.8200	(30)
Total net area of external elements Aum(A, m2)			220.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.7373			(33)
E-WM-30			60.6800	0.0000	0.0000	45.0000	2730.6000	(32)
GF Timber			63.4500			9.0000	571.0500	(32c)
1F Timber			69.1400			9.0000	622.2600	(32c)
TF Timber			75.2500			9.0000	677.2500	(32c)
Internal Floor			39.7800			18.0000	716.0400	(32d)
Internal Floor			28.6400			18.0000	515.5200	(32d)
Internal Ceiling FF			39.7800			9.0000	358.0200	(32e)
Internal Ceiling TF			28.6400			18.0000	515.5200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15399.8890	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.9366	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1278	(36)
Total fabric heat loss	(33) + (36) = 73.8650	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.8395	54.2057	54.2057	53.3129	53.3129	52.2308	52.4897	51.9796	52.2308	52.7564	52.7564	53.6028	(38)
Heat transfer coeff	128.7046	128.0707	128.0707	127.1780	127.1780	126.0958	126.3548	125.8446	126.0958	126.6214	126.6214	127.4678	(39)
Average = Sum(39)m / 12 =												127.0253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1444	1.1388	1.1388	1.1309	1.1309	1.1213	1.1236	1.1190	1.1213	1.1259	1.1259	1.1335	(40)
HLP (average)												1.1295	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8288 (42)

Average daily hot water use (litres/day) 101.3843 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.5227	107.4674	103.4120	99.3566	95.3013	91.2459	91.2459	95.3013	99.3566	103.4120	107.4674	111.5227	(44)
Energy conte	165.3850	144.6468	149.2625	130.1307	124.8635	107.7477	99.8441	114.5725	115.9409	135.1179	147.4918	160.1666	(45)
Energy content (annual)										Total = Sum(45)m =		1595.1701	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8078	21.6970	22.3894	19.5196	18.7295	16.1622	14.9766	17.1859	17.3911	20.2677	22.1238	24.0250	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1535	12.7724	14.1148	13.6231	14.0422	13.5488	13.9752	14.0186	13.5893	14.0808	13.6668	14.1410	(61)
Total heat required for water heating calculated for each month	179.5385	157.4192	163.3773	143.7538	138.9056	121.2965	113.8193	128.5912	129.5302	149.1988	161.1586	174.3075	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1140.0998	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1915.3676	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.2007	(H8)
Utilisation factor	0.5652	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	101.3843	(H14)
Volume ratio Veff/V	0.7398	(H15)
Solar storage volume factor	0.9397	(H16)
Solar input	-894.4782	(H17)

Solar input	-27.5316	-41.3799	-69.6890	-96.3316	-116.0156	-122.1014	-119.1695	-106.4191	-83.0605	-56.5045	-33.4654	-22.8101	(63)
								Solar input (sum of months) = Sum(63)m =				-894.4782	(63)
Output from w/h	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
								Total per year (kWh/year) = Sum(64)m =				872.5734	(64)
Heat gains from water heating, kWh/month	58.5289	51.2882	53.1585	46.6742	45.0276	39.2133	36.6920	41.6000	41.9477	48.4469	52.4577	56.7906	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	169.7288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.2030	57.9127	47.0978	35.6561	26.6533	22.5019	24.3141	31.6043	42.4193	53.8610	62.8637	67.0152	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.5135	414.7733	404.0387	381.1858	352.3382	325.2255	307.1126	302.8527	313.5874	336.4402	365.2878	392.4005	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	54.8017	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	-113.1525	(71)
Water heating gains (Table 5)	78.6679	76.3217	71.4496	64.8253	60.5210	54.4629	49.3172	55.9140	58.2607	65.1168	72.8579	76.3315	(72)
Total internal gains	668.7623	663.3857	636.9640	596.0451	553.8905	516.5682	495.1217	504.7490	528.6453	569.7960	615.3875	650.1252	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.1600	12.9236	0.4600	0.0000	0.7700	9.8875	(75)
Southeast	5.8100	40.4699	0.4600	0.0000	0.7700	83.2831	(77)
Northwest	2.1700	12.9236	0.4600	0.0000	0.7700	9.9332	(81)
Northwest	5.4600	12.9236	0.4600	0.0000	0.7700	24.9933	(81)
Northwest	0.6500	18.7850	0.6300	0.7000	1.0000	4.8463	(82)

Solar gains	132.9433	219.1703	336.6935	499.5410	606.4312	672.8544	629.9589	543.2444	419.8735	270.4261	166.3210	110.6827	(83)
Total gains	801.7056	882.5560	973.6575	1095.5861	1160.3218	1189.4226	1125.0806	1047.9934	948.5187	840.2221	781.7085	760.8078	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	33.2369	33.4014	33.4014	33.6359	33.6359	33.9246	33.8551	33.9923	33.9246	33.7838	33.7838	33.5594
alpha	3.2158	3.2268	3.2268	3.2424	3.2424	3.2616	3.2570	3.2662	3.2616	3.2523	3.2523	3.2373
util living area												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9695	0.9573	0.9262	0.8506	0.7118	0.4964	0.3408	0.3737	0.6582	0.8774	0.9513	0.9734 (86)
MIT	19.3478	19.5299	19.9047	20.3730	20.7498	20.9475	20.9891	20.9855	20.8597	20.4070	19.8190	19.3203 (87)
Th 2	19.9647	19.9693	19.9693	19.9757	19.9757	19.9835	19.9816	19.9853	19.9835	19.9797	19.9797	19.9736 (88)
util rest of house												
	0.9636	0.9491	0.9114	0.8203	0.6537	0.4073	0.2322	0.2600	0.5740	0.8452	0.9403	0.9682 (89)
MIT 2	17.7898	18.0544	18.5897	19.2431	19.7294	19.9492	19.9782	19.9804	19.8709	19.3070	18.4811	17.7561 (90)
Living area fraction									fLA = Living area / (4) =			0.3087 (91)
MIT	18.2708	18.5099	18.9957	19.5920	20.0444	20.2574	20.2903	20.2907	20.1761	19.6466	18.8941	18.2391 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1208	18.3599	18.8457	19.4420	19.8944	20.1074	20.1403	20.1407	20.0261	19.4966	18.7441	18.0891 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9490	0.9320	0.8910	0.8018	0.6486	0.4186	0.2495	0.2779	0.5779	0.8265	0.9225	0.9547	(94)
Useful gains	760.8309	822.5107	867.5067	878.3963	752.5962	497.9237	280.7027	291.1927	548.1556	694.4742	721.1056	726.3552	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1675.8372	1634.1760	1465.8534	1213.5272	876.8196	517.9242	283.0762	294.5622	608.5567	999.8832	1360.4347	1655.6862	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	680.7646	545.4391	445.1700	241.2943	92.4223	0.0000	0.0000	0.0000	0.0000	227.2243	460.3169	691.4223	(98)
Space heating												3384.0538	(98)
Space heating per m2											(98) / (4) =	30.0912	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3739.2859	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	680.7646	545.4391	445.1700	241.2943	92.4223	0.0000	0.0000	0.0000	0.0000	227.2243	460.3169	691.4223	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	752.2261	602.6951	491.9005	266.6235	102.1240	0.0000	0.0000	0.0000	0.0000	251.0766	508.6375	764.0026	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	152.0069	116.0393	93.6883	47.4222	22.8900	0.0000	0.0000	22.1721	46.4697	92.6943	127.6932	151.4974	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8985	89.9218	89.9269	89.9584	89.8463	87.3000	87.3000	87.3000	87.3000	89.5489	89.7853	89.9077	(217)
Fuel for water heating, kWh/month													
	169.0872	129.0447	104.1827	52.7157	25.4769	0.0000	0.0000	25.3976	53.2299	103.5124	142.2206	168.5033	(219)
Water heating fuel used												973.3711	(219)
Annual totals kWh/year													
Space heating fuel - main system												3739.2859	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												460.6022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3474.0996	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3739.2859	3.9200	146.5800	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.3711	3.9200	38.1561	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	460.6022	16.9600	78.1181	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			62.6768	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3739.2859	0.2160	807.6858	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.3711	0.2160	210.2482	(264)
Space and water heating			1017.9339	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	460.6022	0.5190	239.0525	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			375.1226	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3739.2859	1.2200	4561.9289	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.3711	1.2200	1187.5127	(264)
Space and water heating			5749.4416	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	460.6022	3.0700	1414.0488	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1947.0702	(272)
Primary energy kWh/m2/year			17.3134	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	384.18	(P1)
Transmission heat loss coefficient	73.87	(37)
Summer heat loss coefficient	458.04	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	1.00	1.000	1.000	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	2.1600	98.8453	0.4600	0.0000	0.9000	88.3914
South East	5.8100	119.9223	0.4600	0.0000	0.9000	288.4540
North West	2.1700	98.8453	0.4600	0.0000	0.9000	88.8006
North West	5.4600	98.8453	0.4600	0.0000	0.9000	223.4338
North West	0.6500	156.6480	0.6300	0.7000	1.0000	40.4128
total:						729.4927

	Jun	Jul	Aug	
Solar gains	779	729	629	(P3/P4)
Internal gains	514	492	502	
Total summer gains	1293	1222	1131	(P5)
Summer gain/loss ratio	2.82	2.67	2.47	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	19.86	21.61	21.31	(P7)

Likelihood of high internal temperature	Not significant	Slight	Slight
Assessment of likelihood of high internal temperature:	Slight		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-322	**Issued on Date**	19/10/2022
Assessment Reference	Plot 321	**Prop Type Ref**	Maplethorne-As-DET
Property	Plot 322, 3 Bed, K, WC, B, En		

SAP Rating	84 B	**DER**	17.96	**TER**	18.88
Environmental	85 B	**% DER<TER**	4.89		
CO_2 Emissions (t/year)	1.42	**DFEE**	51.97	**TFEE**	58.70
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.47		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.88 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.96 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.64 m², No overhang
Windows facing East: 0.72 m², No overhang
Windows facing South: 5.06 m², No overhang
Windows facing West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4122	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.7096	125.2718	124.8426	122.8271	122.4500	120.6945	120.6945	120.3694	121.3707	122.4500	123.2128	124.0104	(39)
Average = Sum(39)m / 12 =												122.8253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3134	1.3089	1.3044	1.2833	1.2794	1.2610	1.2610	1.2576	1.2681	1.2794	1.2874	1.2957	(40)
HLP (average)												1.2833	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	538.1515	625.0616	698.6208	768.3995	814.4857	798.5352	761.4662	712.6358	661.2072	590.0995	528.9488	507.5930	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6767	35.8014	35.9244	36.5139	36.6264	37.1591	37.1591	37.2595	36.9521	36.6264	36.3996	36.1655	
alpha	3.3784	3.3868	3.3950	3.4343	3.4418	3.4773	3.4773	3.4840	3.4635	3.4418	3.4266	3.4110	
util living area													
	0.9925	0.9869	0.9754	0.9470	0.8840	0.7636	0.6221	0.6708	0.8575	0.9607	0.9876	0.9939	(86)
MIT	19.0122	19.2201	19.5634	20.0298	20.4638	20.7908	20.9263	20.9026	20.6528	20.0954	19.4790	18.9864	(87)
Th 2	19.8303	19.8339	19.8374	19.8539	19.8570	19.8715	19.8715	19.8742	19.8659	19.8570	19.8508	19.8442	(88)
util rest of house													
	0.9907	0.9836	0.9689	0.9317	0.8466	0.6816	0.4917	0.5451	0.7974	0.9464	0.9840	0.9924	(89)
MIT 2	17.1906	17.4952	17.9954	18.6745	19.2770	19.6984	19.8330	19.8182	19.5415	18.7787	17.8845	17.1613	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.4677	17.7576	18.2339	18.8807	19.4576	19.8645	19.9993	19.9832	19.7106	18.9790	18.1271	17.4390	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3177	17.6076	18.0839	18.7307	19.3076	19.7145	19.8493	19.8332	19.5606	18.8290	17.9771	17.2890	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9842	0.9740	0.9544	0.9110	0.8238	0.6683	0.4888	0.5399	0.7769	0.9276	0.9746	0.9869	(94)
Useful gains	529.6541	608.7833	666.7752	700.0086	670.9786	533.6367	372.2185	384.7675	513.6683	547.3583	515.4895	500.9375	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1636.4468	1591.9034	1446.1684	1207.4789	931.5449	617.2977	392.1703	413.2471	662.7530	1007.6403	1340.1961	1623.1704	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	823.4538	660.6567	579.8685	365.3786	193.8613	0.0000	0.0000	0.0000	0.0000	342.4498	593.7888	834.9413	(98)
Space heating												4394.3988	(98)
Space heating per m2											(98) / (4) =	45.9137	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4855.6892	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	823.4538	660.6567	579.8685	365.3786	193.8613	0.0000	0.0000	0.0000	0.0000	342.4498	593.7888	834.9413	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	909.8937	730.0074	640.7386	403.7333	214.2114	0.0000	0.0000	0.0000	0.0000	378.3975	656.1202	922.5870	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9240	89.8808	89.7927	89.5917	89.1584	87.3000	87.3000	87.3000	87.3000	89.5239	89.8131	89.9441	(217)
Fuel for water heating, kWh/month													
	193.9246	170.1272	176.7694	155.9177	151.4232	135.0886	126.8064	143.1997	144.2255	161.9547	174.3202	188.2461	(219)
Water heating fuel used												1922.0033	(219)
Annual totals kWh/year													
Space heating fuel - main system												4855.6892	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7268.7719	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4855.6892	0.2160	1048.8289	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.0033	0.2160	415.1527	(264)
Space and water heating			1463.9816	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/year			1718.8518	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.9600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.9600	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		35.3084	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.3084	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.1800	20.6388			(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.1800	3.0942			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.0528			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5562	(36)
Total fabric heat loss (33) + (36) =	67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462 (64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678 (64)
Heat gains from water heating, kWh/month												
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6400	10.6334	0.6300	0.7000	0.7700	24.8277	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	5.0600	46.7521	0.6300	0.7000	0.7700	72.2975	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	105.7685	182.7599	259.2961	340.5806	401.8595	408.6565	389.8961	342.2076	286.8778	204.2531	127.1026	90.2772	(83)
Total gains	533.7078	608.3817	669.7815	726.0139	761.6960	744.0053	709.9268	669.3371	627.3704	570.0222	521.1234	505.6162	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9985	0.9970	0.9929	0.9792	0.9357	0.8206	0.6610	0.7131	0.9090	0.9854	0.9971	0.9989	(86)
MIT	19.6160	19.7601	20.0026	20.3359	20.6537	20.8869	20.9706	20.9575	20.7889	20.3840	19.9448	19.5964	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9980	0.9959	0.9902	0.9703	0.9050	0.7351	0.5210	0.5777	0.8531	0.9776	0.9958	0.9985	(89)
MIT 2	18.0535	18.2661	18.6215	19.1125	19.5557	19.8481	19.9195	19.9142	19.7421	19.1876	18.5462	18.0328	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2912	18.4934	18.8316	19.2986	19.7227	20.0062	20.0794	20.0729	19.9013	19.3696	18.7590	18.2707	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2912	18.4934	18.8316	19.2986	19.7227	20.0062	20.0794	20.0729	19.9013	19.3696	18.7590	18.2707	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9938	0.9862	0.9633	0.8979	0.7421	0.5419	0.5972	0.8514	0.9717	0.9938	0.9976	(94)
Useful gains	532.0236	604.5960	660.5534	699.3443	683.8904	552.1036	384.7414	399.7568	534.1382	553.8897	517.8729	504.3851	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1645.0618	1593.4639	1441.2580	1198.3354	922.0806	613.6516	394.9410	415.9385	661.6907	1007.9209	1347.2259	1635.0137	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	828.1004	664.5193	580.8442	359.2736	177.2135	0.0000	0.0000	0.0000	0.0000	337.7992	597.1341	841.1877	(98)
Space heating												4386.0721	(98)
Space heating per m2											(98) / (4) =	45.8267	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4696.0086	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	828.1004	664.5193	580.8442	359.2736	177.2135	0.0000	0.0000	0.0000	0.0000	337.7992	597.1341	841.1877	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	886.6171	711.4767	621.8889	384.6613	189.7361	0.0000	0.0000	0.0000	0.0000	361.6694	639.3299	900.6292	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1470	87.9782	87.6238	86.8421	85.1852	80.3000	80.3000	80.3000	80.3000	86.5884	87.7134	88.2160	(217)
Fuel for water heating, kWh/month													
	239.6027	211.6176	223.2056	199.8567	197.2602	184.3053	176.5785	196.8436	199.0176	210.0470	219.1474	233.6834	(219)
Water heating fuel used												2491.1657	(219)
Annual totals kWh/year													
Space heating fuel - main system												4696.0086	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7678.2537	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4696.0086	0.2160	1014.3379	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2491.1657	0.2160	538.0918	(264)
Space and water heating			1552.4296	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1807.2998	(272)
Emissions per m2 for space and water heating			16.2201	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2201 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.8800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3718	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3718	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4740	0.4647	0.4554	0.4089	0.3996	0.3532	0.3532	0.3439	0.3718	0.3996	0.4182	0.4368	(22b)
Effective ac	0.6123	0.6080	0.6037	0.5836	0.5799	0.5624	0.5624	0.5591	0.5691	0.5799	0.5875	0.5954	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9941	49.6379	49.2889	47.6492	47.3424	45.9144	45.9144	45.6499	46.4644	47.3424	47.9630	48.6118	(38)
Heat transfer coeff	123.6068	123.2507	122.9016	121.2620	120.9552	119.5271	119.5271	119.2626	120.0772	120.9552	121.5758	122.2246	(39)
Average = Sum(39)m / 12 =												121.2605	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2915	1.2878	1.2841	1.2670	1.2638	1.2488	1.2488	1.2461	1.2546	1.2638	1.2703	1.2770	(40)
HLP (average)												1.2670	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	504.5541	592.2872	667.5555	739.6617	787.2599	773.4361	738.1715	687.0256	634.7718	561.2557	497.3894	474.8151	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2836	36.3884	36.4918	36.9852	37.0790	37.5220	37.5220	37.6052	37.3501	37.0790	36.8897	36.6939	
alpha	3.4189	3.4259	3.4328	3.4657	3.4719	3.5015	3.5015	3.5070	3.4900	3.4719	3.4593	3.4463	
util living area													
	0.9939	0.9888	0.9782	0.9515	0.8910	0.7736	0.6326	0.6838	0.8677	0.9655	0.9897	0.9950	(86)
MIT	19.0050	19.2129	19.5562	20.0197	20.4558	20.7850	20.9240	20.8983	20.6423	20.0798	19.4634	18.9749	(87)
Th 2	19.8475	19.8504	19.8533	19.8668	19.8693	19.8811	19.8811	19.8833	19.8766	19.8693	19.8642	19.8589	(88)
util rest of house													
	0.9924	0.9860	0.9724	0.9373	0.8553	0.6932	0.5024	0.5590	0.8104	0.9527	0.9866	0.9938	(89)
MIT 2	18.0334	18.2423	18.5847	19.0494	19.4648	19.7585	19.8536	19.8428	19.6458	19.1157	18.5028	18.0117	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1812	18.3899	18.7325	19.1971	19.6156	19.9147	20.0165	20.0034	19.7974	19.2624	18.6490	18.1582	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1812	18.3899	18.7325	19.1971	19.6156	19.9147	20.0165	20.0034	19.7974	19.2624	18.6490	18.1582	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9811	0.9648	0.9265	0.8455	0.6960	0.5198	0.5741	0.8054	0.9434	0.9820	0.9912	(94)
Useful gains	499.1058	581.0650	644.0466	685.3051	665.6389	538.3035	383.6880	394.4371	511.2668	529.4702	488.4370	470.6265	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1715.8123	1662.6421	1503.3968	1248.6405	957.4276	635.2473	408.3601	429.7484	684.1252	1047.7570	1404.0735	1706.0399	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	905.2296	726.8198	639.3565	405.6015	217.0908	0.0000	0.0000	0.0000	0.0000	385.6054	659.2583	919.1475	(98)
Space heating												4858.1094	(98)
Space heating per m2											(98) / (4) =	50.7586	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1123.5548	884.5005	906.3961	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7335	0.8100	0.7780	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	824.1814	716.4351	705.1417	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.1881	963.8191	906.0197	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	131.7648	184.0537	149.4532	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												465.2717	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	32.9412	46.0134	37.3633	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												116.3179	(107)
Space cooling per m2												1.2153	(108)
Energy for space heating												50.7586	(99)
Energy for space cooling												1.2153	(108)
Total												51.9740	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.1800	20.6388			(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.1800	3.0942			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.0528			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5562	(36)
Total fabric heat loss (33) + (36) =	67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243 (72)

Total internal gains

	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6400	10.6334	0.6300	0.7000	0.7700	24.8277	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	5.0600	46.7521	0.6300	0.7000	0.7700	72.2975	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	105.7685	182.7599	259.2961	340.5806	401.8595	408.6565	389.8961	342.2076	286.8778	204.2531	127.1026	90.2772 (83)
Total gains	487.7388	563.2316	626.3320	685.5155	723.3715	708.4671	676.1850	632.6207	589.1634	528.7832	477.1824	460.4627 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area	0.9990	0.9978	0.9946	0.9834	0.9460	0.8409	0.6861	0.7415	0.9253	0.9893	0.9980	0.9993	(86)
MIT	19.5718	19.7170	19.9618	20.3002	20.6261	20.8725	20.9654	20.9494	20.7645	20.3465	19.9027	19.5528	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house	0.9987	0.9971	0.9925	0.9761	0.9189	0.7592	0.5445	0.6063	0.8759	0.9833	0.9972	0.9990	(89)
MIT 2	18.5943	18.7416	18.9879	19.3333	19.6471	19.8657	19.9215	19.9173	19.7820	19.3835	18.9383	18.5845	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.7430	18.8900	19.1360	19.4804	19.7960	20.0188	20.0803	20.0743	19.9315	19.5299	19.0850	18.7318	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7430	18.8900	19.1360	19.4804	19.7960	20.0188	20.0803	20.0743	19.9315	19.5299	19.0850	18.7318	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9960	0.9905	0.9722	0.9150	0.7671	0.5661	0.6264	0.8762	0.9802	0.9962	0.9986	(94)
Useful gains	486.8312	560.9916	620.3711	666.4239	661.8783	543.4498	382.7621	396.2456	516.2265	518.3250	475.3671	459.8187	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1698.1893	1639.9559	1476.8370	1219.2851	930.5096	615.0903	395.0508	416.0966	665.1267	1026.3540	1384.9004	1688.5901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	901.2504	725.0640	637.2106	398.0601	199.8617	0.0000	0.0000	0.0000	0.0000	377.9736	654.8639	914.2059	(98)
Space heating												4808.4902	(98)
Space heating per m2											(98) / (4) =	50.2402	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7696	0.8543	0.8219	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	821.1529	717.5810	707.3429	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	931.2502	891.3674	842.4295	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	79.2701	129.2970	100.5044	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												309.0716 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	19.8175	32.3243	25.1261	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												77.2679 (107)
Space cooling per m2												0.8073 (108)
Energy for space heating												50.2402 (99)
Energy for space cooling												0.8073 (108)
Total												51.0475 (109)
Target Fabric Energy Efficiency (TFEE)												58.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.0815	121.3707	121.3707	120.3694	120.3694	119.1557	119.4461	118.8740	119.1557	119.7452	119.7452	120.6945	(39)
Average = Sum(39)m / 12 =												120.1982	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2681	1.2681	1.2576	1.2576	1.2450	1.2480	1.2420	1.2450	1.2511	1.2511	1.2610	(40)
HLP (average)												1.2559	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
								Total per year (kWh/year) = Sum(64)m =				1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	11.9814	0.4600	0.0000	0.7700	18.2909	(74)
East	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(76)
South	5.0600	50.9848	0.4600	0.0000	0.7700	91.3777	(78)
West	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(80)
North	3.3300	11.9814	0.4600	0.0000	0.7700	14.1319	(74)

Solar gains	135.1905	210.5984	296.6575	404.5610	467.5304	509.7611	480.7299	429.7709	356.7990	251.6945	166.5025	114.2423	(83)
Total gains	753.1920	823.6006	885.4435	955.8842	980.4140	988.4601	939.6693	897.8276	846.6248	779.2075	735.7854	715.2061	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7369	36.9521	36.9521	37.2595	37.2595	37.6390	37.5475	37.7282	37.6390	37.4537	37.4537	37.1591	
alpha	3.4491	3.4635	3.4635	3.4840	3.4840	3.5093	3.5032	3.5152	3.5093	3.4969	3.4969	3.4773	
util living area													
	0.9763	0.9664	0.9428	0.8860	0.7700	0.5576	0.3848	0.4115	0.6936	0.8948	0.9603	0.9795	(86)
MIT	19.4549	19.6224	19.9528	20.3705	20.7322	20.9424	20.9887	20.9859	20.8659	20.4479	19.9043	19.4332	(87)
Th 2	19.8600	19.8659	19.8659	19.8742	19.8742	19.8842	19.8818	19.8865	19.8842	19.8793	19.8793	19.8715	(88)
util rest of house													
	0.9707	0.9585	0.9286	0.8561	0.7071	0.4503	0.2504	0.2741	0.5978	0.8606	0.9492	0.9746	(89)
MIT 2	17.8503	18.0947	18.5672	19.1537	19.6212	19.8506	19.8791	19.8828	19.7858	19.2737	18.5125	17.8266	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.0944	18.3271	18.7780	19.3388	19.7902	20.0167	20.0479	20.0506	19.9502	19.4523	18.7242	18.0710	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9444	18.1771	18.6280	19.1888	19.6402	19.8667	19.8979	19.9006	19.8002	19.3023	18.5742	17.9210	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9569	0.9420	0.9079	0.8335	0.6920	0.4485	0.2524	0.2759	0.5897	0.8381	0.9313	0.9621	(94)
Useful gains	720.7441	775.8101	803.8780	796.7687	678.4449	443.2972	237.1772	247.6981	499.2157	653.0639	685.2010	688.0736	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1568.0638	1526.4950	1362.7447	1118.0822	799.2751	460.7436	238.6435	249.7101	548.1342	922.3165	1266.2080	1547.4192	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	630.4059	504.4603	415.7969	231.3457	89.8977	0.0000	0.0000	0.0000	0.0000	200.3239	418.3251	639.3532	(98)
Space heating												3129.9086	(98)
RHI space heating demand												3130	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4122	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.7096	125.2718	124.8426	122.8271	122.4500	120.6945	120.6945	120.3694	121.3707	122.4500	123.2128	124.0104	(39)
Average = Sum(39)m / 12 =												122.8253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3134	1.3089	1.3044	1.2833	1.2794	1.2610	1.2610	1.2576	1.2681	1.2794	1.2874	1.2957	(40)
HLP (average)												1.2833	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	740.5853	824.8177	889.3055	946.0501	978.6315	952.3244	910.8220	864.6692	822.3120	764.2386	716.5926	705.5934	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6767	35.8014	35.9244	36.5139	36.6264	37.1591	37.1591	37.2595	36.9521	36.6264	36.3996	36.1655	
alpha	3.3784	3.3868	3.3950	3.4343	3.4418	3.4773	3.4773	3.4840	3.4635	3.4418	3.4266	3.4110	
util living area													
	0.9806	0.9708	0.9523	0.9109	0.8296	0.6895	0.5422	0.5840	0.7830	0.9231	0.9700	0.9834	(86)
MIT	19.2562	19.4539	19.7740	20.2013	20.5815	20.8511	20.9521	20.9373	20.7515	20.2728	19.6997	19.2280	(87)
Th 2	19.8303	19.8339	19.8374	19.8539	19.8570	19.8715	19.8715	19.8742	19.8659	19.8570	19.8508	19.8442	(88)
util rest of house													
	0.9762	0.9641	0.9408	0.8879	0.7827	0.6028	0.4198	0.4630	0.7097	0.8985	0.9619	0.9796	(89)
MIT 2	17.5436	17.8311	18.2933	18.9071	19.4204	19.7544	19.8479	19.8405	19.6475	19.0191	18.2005	17.5115	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8042	18.0780	18.5185	19.1040	19.5970	19.9212	20.0159	20.0073	19.8154	19.2098	18.4285	17.7726	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6542	17.9280	18.3685	18.9540	19.4470	19.7712	19.8659	19.8573	19.6654	19.0598	18.2785	17.6226	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9638	0.9484	0.9210	0.8649	0.7626	0.5942	0.4191	0.4610	0.6944	0.8758	0.9459	0.9684	(94)
Useful gains	713.7706	782.2378	819.0137	818.2002	746.3529	565.8605	381.7288	398.6019	571.0439	669.2884	677.8075	683.3300	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1678.7470	1632.0360	1481.6986	1234.9013	948.6257	624.1401	394.1720	416.1555	675.4787	1035.9050	1377.3409	1664.5437	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	717.9424	571.0644	493.0376	300.0247	150.4910	0.0000	0.0000	0.0000	0.0000	272.7628	503.6641	730.0231	(98)
Space heating												3739.0101	(98)
Space heating per m2											(98) / (4) =	39.0660	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4131.5029	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	717.9424	571.0644	493.0376	300.0247	150.4910	0.0000	0.0000	0.0000	0.0000	272.7628	503.6641	730.0231	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	793.3066	631.0104	544.7929	331.5191	166.2884	0.0000	0.0000	0.0000	0.0000	301.3953	556.5349	806.6553	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8563	89.8047	89.6993	89.4583	88.9580	87.3000	87.3000	87.3000	87.3000	89.3631	89.7201	89.8797	(217)
Fuel for water heating, kWh/month													
	194.0706	170.2713	176.9534	156.1502	151.7642	135.0886	126.8064	143.1997	144.2255	162.2461	174.5008	188.3810	(219)
Water heating fuel used												1923.6578	(219)
Annual totals kWh/year													
Space heating fuel - main system												4131.5029	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												6546.2401	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4131.5029	3.4800	143.7763	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1923.6578	3.4800	66.9433	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Total energy cost			395.4930	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1805	(257)
SAP value		83.5321	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4131.5029	0.2160	892.4046	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1923.6578	0.2160	415.5101	(264)
Space and water heating			1307.9147	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1562.7849	(272)
CO2 emissions per m2			16.3300	(273)
EI value			85.1174	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4122	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.0815	121.3707	121.3707	120.3694	120.3694	119.1557	119.4461	118.8740	119.1557	119.7452	119.7452	120.6945	(39)
Average = Sum(39)m / 12 =												120.1982	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2681	1.2681	1.2576	1.2576	1.2450	1.2480	1.2420	1.2450	1.2511	1.2511	1.2610	(40)
HLP (average)												1.2559	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	11.9814	0.4600	0.0000	0.7700	18.2909	(74)
East	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(76)
South	5.0600	50.9848	0.4600	0.0000	0.7700	91.3777	(78)
West	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(80)
North	3.3300	11.9814	0.4600	0.0000	0.7700	14.1319	(74)

Solar gains	135.1905	210.5984	296.6575	404.5610	467.5304	509.7611	480.7299	429.7709	356.7990	251.6945	166.5025	114.2423	(83)
Total gains	753.1920	823.6006	885.4435	955.8842	980.4140	988.4601	939.6693	897.8276	846.6248	779.2075	735.7854	715.2061	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7369	36.9521	36.9521	37.2595	37.2595	37.6390	37.5475	37.7282	37.6390	37.4537	37.4537	37.1591	
alpha	3.4491	3.4635	3.4635	3.4840	3.4840	3.5093	3.5032	3.5152	3.5093	3.4969	3.4969	3.4773	
util living area													
	0.9763	0.9664	0.9428	0.8860	0.7700	0.5576	0.3848	0.4115	0.6936	0.8948	0.9603	0.9795	(86)
MIT	19.4549	19.6224	19.9528	20.3705	20.7322	20.9424	20.9887	20.9859	20.8659	20.4479	19.9043	19.4332	(87)
Th 2	19.8600	19.8659	19.8659	19.8742	19.8742	19.8842	19.8818	19.8865	19.8842	19.8793	19.8793	19.8715	(88)
util rest of house													
	0.9707	0.9585	0.9286	0.8561	0.7071	0.4503	0.2504	0.2741	0.5978	0.8606	0.9492	0.9746	(89)
MIT 2	17.8503	18.0947	18.5672	19.1537	19.6212	19.8506	19.8791	19.8828	19.7858	19.2737	18.5125	17.8266	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.0944	18.3271	18.7780	19.3388	19.7902	20.0167	20.0479	20.0506	19.9502	19.4523	18.7242	18.0710	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9444	18.1771	18.6280	19.1888	19.6402	19.8667	19.8979	19.9006	19.8002	19.3023	18.5742	17.9210	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9569	0.9420	0.9079	0.8335	0.6920	0.4485	0.2524	0.2759	0.5897	0.8381	0.9313	0.9621	(94)
Useful gains	720.7441	775.8101	803.8780	796.7687	678.4449	443.2972	237.1772	247.6981	499.2157	653.0639	685.2010	688.0736	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1568.0638	1526.4950	1362.7447	1118.0822	799.2751	460.7436	238.6435	249.7101	548.1342	922.3165	1266.2080	1547.4192	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	630.4059	504.4603	415.7969	231.3457	89.8977	0.0000	0.0000	0.0000	0.0000	200.3239	418.3251	639.3532	(98)
Space heating												3129.9086	(98)
Space heating per m2											(98) / (4) =	32.7020	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3458.4625	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	630.4059	504.4603	415.7969	231.3457	89.8977	0.0000	0.0000	0.0000	0.0000	200.3239	418.3251	639.3532	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	696.5811	557.4147	459.4440	255.6306	99.3345	0.0000	0.0000	0.0000	0.0000	221.3524	462.2377	706.4676	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7869	89.7349	89.5927	89.2681	88.5516	87.3000	87.3000	87.3000	87.3000	89.1283	89.6055	89.8107	(217)
Fuel for water heating, kWh/month	194.2207	170.4038	177.1639	156.4829	152.4608	135.0886	126.8064	143.1997	144.2255	162.6736	174.7241	188.5257	(219)
Water heating fuel used												1925.9759	(219)
Annual totals kWh/year													
Space heating fuel - main system												3458.4625	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												5875.5178	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3458.4625	3.9200	135.5717	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1925.9759	3.9200	75.4983	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Total energy cost			382.3570	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3458.4625	0.2160	747.0279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.9759	0.2160	416.0108	(264)
Space and water heating			1163.0387	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1417.9089	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3458.4625	1.2200	4219.3243	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1925.9759	1.2200	2349.6906	(264)
Space and water heating			6569.0149	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Primary energy kWh/year			8076.6285	(272)
Primary energy kWh/m2/year			84.3865	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 30	-188 kg (13.3%)
U Solar photovoltaic panels	+ 9.5	-£ 309	-947 kg (77.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.96 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.89 kg/m²	A 94	A 95
Total Savings	£340	11.86 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£83	£92	-£8
Mains gas	£299	£260	£39
Space heating	£236	£236	£0
Water heating	£75	£45	£30
Lighting	£71	£71	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£382	£43	£340
Total cost of uses	£382	£43	£339
Delivered energy	61 kWh/m²	32 kWh/m²	29 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	84 kWh/m²	15 kWh/m²	70 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16145.6370	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.6933	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.6127	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.7096	125.2718	124.8426	122.8271	122.4500	120.6945	120.6945	120.3694	121.3707	122.4500	123.2128	124.0104	(39)
Average = Sum(39)m / 12 =												122.8253	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3134	1.3089	1.3044	1.2833	1.2794	1.2610	1.2610	1.2576	1.2681	1.2794	1.2874	1.2957	(40)
HLP (average)												1.2833	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1734	(H8)
Utilisation factor												0.5735	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-865.2421	(H17)
Solar input	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963	(63)
								Solar input (sum of months) = Sum(63)m =				-865.2421	(63)
Output from w/h													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
								Total per year (kWh/year) = Sum(64)m =				849.7380	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	10.6334	0.4600	0.0000	0.7700	16.2330	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	5.0600	46.7521	0.4600	0.0000	0.7700	83.7915	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
North	3.3300	10.6334	0.4600	0.0000	0.7700	12.5419	(74)

Solar gains	122.5839	211.8155	300.5195	394.7269	465.7479	473.6255	451.8826	396.6125	332.4863	236.7256	147.3096	104.6296	(83)
Total gains	740.5853	824.8177	889.3055	946.0501	978.6315	952.3244	910.8220	864.6692	822.3120	764.2386	716.5926	705.5934	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6767	35.8014	35.9244	36.5139	36.6264	37.1591	37.1591	37.2595	36.9521	36.6264	36.3996	36.1655	
alpha	3.3784	3.3868	3.3950	3.4343	3.4418	3.4773	3.4773	3.4840	3.4635	3.4418	3.4266	3.4110	
util living area													
	0.9806	0.9708	0.9523	0.9109	0.8296	0.6895	0.5422	0.5840	0.7830	0.9231	0.9700	0.9834	(86)
MIT	19.2562	19.4539	19.7740	20.2013	20.5815	20.8511	20.9521	20.9373	20.7515	20.2728	19.6997	19.2280	(87)
Th 2	19.8303	19.8339	19.8374	19.8539	19.8570	19.8715	19.8715	19.8742	19.8659	19.8570	19.8508	19.8442	(88)
util rest of house													
	0.9762	0.9641	0.9408	0.8879	0.7827	0.6028	0.4198	0.4630	0.7097	0.8985	0.9619	0.9796	(89)
MIT 2	17.5436	17.8311	18.2933	18.9071	19.4204	19.7544	19.8479	19.8405	19.6475	19.0191	18.2005	17.5115	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8042	18.0780	18.5185	19.1040	19.5970	19.9212	20.0159	20.0073	19.8154	19.2098	18.4285	17.7726	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6542	17.9280	18.3685	18.9540	19.4470	19.7712	19.8659	19.8573	19.6654	19.0598	18.2785	17.6226	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9638	0.9484	0.9210	0.8649	0.7626	0.5942	0.4191	0.4610	0.6944	0.8758	0.9459	0.9684	(94)
Useful gains	713.7706	782.2378	819.0137	818.2002	746.3529	565.8605	381.7288	398.6019	571.0439	669.2884	677.8075	683.3300	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1678.7470	1632.0360	1481.6986	1234.9013	948.6257	624.1401	394.1720	416.1555	675.4787	1035.9050	1377.3409	1664.5437	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	717.9424	571.0644	493.0376	300.0247	150.4910	0.0000	0.0000	0.0000	0.0000	272.7628	503.6641	730.0231	(98)
Space heating												3739.0101	(98)
Space heating per m2											(98) / (4) =	39.0660	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4131.5029	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	717.9424	571.0644	493.0376	300.0247	150.4910	0.0000	0.0000	0.0000	0.0000	272.7628	503.6641	730.0231	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	793.3066	631.0104	544.7929	331.5191	166.2884	0.0000	0.0000	0.0000	0.0000	301.3953	556.5349	806.6553	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9325	89.9632	90.0031	90.0767	90.1655	87.3000	87.3000	87.3000	87.3000	89.6746	89.8377	89.9433	(217)
Fuel for water heating, kWh/month	166.0072	123.4318	97.1289	48.9851	18.7917	2.1281	0.0000	28.5666	54.4449	101.9965	141.1453	164.9040	(219)
Water heating fuel used												947.5301	(219)
Annual totals kWh/year													
Space heating fuel - main system												4131.5029	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3892.8730	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4131.5029	3.4800	143.7763	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.5301	3.4800	32.9740	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			140.2958	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4188	(257)
SAP value	94.1582	
SAP rating (Section 12)	94	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4131.5029	0.2160	892.4046	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.5301	0.2160	204.6665	(264)
Space and water heating			1097.0711	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			481.4541	(272)
CO2 emissions per m2			5.0300	(273)
EI value			95.4150	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	128.0400	13.3800	114.6600	0.2500	28.6650	52.3000	5996.7180	(29a)
EW WBoard AAC015	20.0800	2.8900	17.1900	0.2400	4.1256	52.1000	895.5990	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.9124			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16145.6370 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.6933 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.6127 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.0815	121.3707	121.3707	120.3694	120.3694	119.1557	119.4461	118.8740	119.1557	119.7452	119.7452	120.6945	(39)
Average = Sum(39)m / 12 =												120.1982	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2681	1.2681	1.2576	1.2576	1.2450	1.2480	1.2420	1.2450	1.2511	1.2511	1.2610	(40)
HLP (average)												1.2559	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2393	(H8)
Utilisation factor												0.5538	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-882.3194	(H17)
Solar input	-27.1574	-40.8174	-68.7417	-95.0221	-114.4386	-120.4417	-117.5496	-104.9725	-81.9314	-55.7364	-33.0105	-22.5000	(63)
								Solar input (sum of months) = Sum(63)m =				-882.3194	(63)
Output from w/h													
	147.2273	112.0942	89.9842	44.6672	20.5678	0.0000	0.0000	20.0408	43.9775	89.2518	123.5519	146.8163	(64)
								Total per year (kWh/year) = Sum(64)m =				838.1790	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3100	11.9814	0.4600	0.0000	0.7700	18.2909	(74)
East	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(76)
South	5.0600	50.9848	0.4600	0.0000	0.7700	91.3777	(78)
West	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(80)
North	3.3300	11.9814	0.4600	0.0000	0.7700	14.1319	(74)

Solar gains	135.1905	210.5984	296.6575	404.5610	467.5304	509.7611	480.7299	429.7709	356.7990	251.6945	166.5025	114.2423	(83)
Total gains	753.1920	823.6006	885.4435	955.8842	980.4140	988.4601	939.6693	897.8276	846.6248	779.2075	735.7854	715.2061	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.7369	36.9521	36.9521	37.2595	37.2595	37.6390	37.5475	37.7282	37.6390	37.4537	37.4537	37.1591	
alpha	3.4491	3.4635	3.4635	3.4840	3.4840	3.5093	3.5032	3.5152	3.5093	3.4969	3.4969	3.4773	
util living area													
	0.9763	0.9664	0.9428	0.8860	0.7700	0.5576	0.3848	0.4115	0.6936	0.8948	0.9603	0.9795	(86)
MIT	19.4549	19.6224	19.9528	20.3705	20.7322	20.9424	20.9887	20.9859	20.8659	20.4479	19.9043	19.4332	(87)
Th 2	19.8600	19.8659	19.8659	19.8742	19.8742	19.8842	19.8818	19.8865	19.8842	19.8793	19.8793	19.8715	(88)
util rest of house													
	0.9707	0.9585	0.9286	0.8561	0.7071	0.4503	0.2504	0.2741	0.5978	0.8606	0.9492	0.9746	(89)
MIT 2	17.8503	18.0947	18.5672	19.1537	19.6212	19.8506	19.8791	19.8828	19.7858	19.2737	18.5125	17.8266	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.0944	18.3271	18.7780	19.3388	19.7902	20.0167	20.0479	20.0506	19.9502	19.4523	18.7242	18.0710	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9444	18.1771	18.6280	19.1888	19.6402	19.8667	19.8979	19.9006	19.8002	19.3023	18.5742	17.9210	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9569	0.9420	0.9079	0.8335	0.6920	0.4485	0.2524	0.2759	0.5897	0.8381	0.9313	0.9621	(94)
Useful gains	720.7441	775.8101	803.8780	796.7687	678.4449	443.2972	237.1772	247.6981	499.2157	653.0639	685.2010	688.0736	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1568.0638	1526.4950	1362.7447	1118.0822	799.2751	460.7436	238.6435	249.7101	548.1342	922.3165	1266.2080	1547.4192	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	630.4059	504.4603	415.7969	231.3457	89.8977	0.0000	0.0000	0.0000	0.0000	200.3239	418.3251	639.3532	(98)
Space heating												3129.9086	(98)
Space heating per m2											(98) / (4) =	32.7020	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3458.4625	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	630.4059	504.4603	415.7969	231.3457	89.8977	0.0000	0.0000	0.0000	0.0000	200.3239	418.3251	639.3532	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	696.5811	557.4147	459.4440	255.6306	99.3345	0.0000	0.0000	0.0000	0.0000	221.3524	462.2377	706.4676	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	147.2273	112.0942	89.9842	44.6672	20.5678	0.0000	0.0000	20.0408	43.9775	89.2518	123.5519	146.8163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8763	89.9009	89.9136	89.9663	89.8865	87.3000	87.3000	87.3000	87.3000	89.4890	89.7499	89.8847	(217)
Fuel for water heating, kWh/month	163.8111	124.6865	100.0785	49.6488	22.8820	0.0000	0.0000	22.9562	50.3751	99.7349	137.6624	163.3385	(219)
Water heating fuel used												935.1740	(219)
Annual totals kWh/year													
Space heating fuel - main system												3458.4625	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3110.5563	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3458.4625	3.9200	135.5717	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	935.1740	3.9200	36.6588	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			42.6201	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3458.4625	0.2160	747.0279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.1740	0.2160	201.9976	(264)
Space and water heating			949.0255	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			283.1068 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3458.4625	1.2200	4219.3243	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.1740	1.2200	1140.9123	(264)
Space and water heating			5360.2366	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1421.1801	(272)
Primary energy kWh/m2/year			14.8488	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.61 (37)
Summer heat loss coefficient		400.19 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.3100	81.1852	0.4600	0.0000	0.9000	144.8620
East	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
South	5.0600	112.2060	0.4600	0.0000	0.9000	235.0536
West	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
North	3.3300	81.1852	0.4600	0.0000	0.9000	111.9235
total:						561.8921

	Jun	Jul	Aug	
Solar gains	596	562	502	(P4)
Internal gains	476	456	465	
Total summer gains	1072	1018	967	(P5)
Summer gain/loss ratio	2.68	2.54	2.42	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.50	21.26	21.04	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-323	**Issued on Date**	19/10/2022
Assessment Reference	Plot 323	**Prop Type Ref**	Islington-As-DET
Property	Plot 323, 3 Bed, K, WC, Ut, B, En		

SAP Rating	83 B	**DER**	18.03	**TER**	19.00
Environmental	85 B	**% DER<TER**	5.10		
CO_2 Emissions (t/year)	1.50	**DFEE**	53.53	**TFEE**	60.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.92		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.00 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.03 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 6.36 m², No overhang
Windows facing North West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	542.6957	633.1929	724.0748	823.7343	895.9616	887.3742	843.5044	773.9488	695.3660	601.4748	532.7547	511.6465	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9921	0.9864	0.9735	0.9401	0.8674	0.7386	0.5992	0.6556	0.8530	0.9604	0.9873	0.9935	(86)
MIT	18.8712	19.0872	19.4623	19.9801	20.4493	20.7887	20.9240	20.8962	20.6224	20.0178	19.3655	18.8493	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9902	0.9831	0.9668	0.9236	0.8276	0.6555	0.4710	0.5311	0.7931	0.9463	0.9837	0.9920	(89)
MIT 2	16.9845	17.3013	17.8479	18.6009	19.2495	19.6853	19.8199	19.8026	19.4976	18.6677	17.7201	16.9620	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3126	17.6119	18.1287	18.8408	19.4582	19.8772	20.0120	19.9928	19.6932	18.9025	18.0063	17.2903	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1626	17.4619	17.9787	18.6908	19.3082	19.7272	19.8620	19.8428	19.5432	18.7525	17.8563	17.1403	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9729	0.9513	0.9014	0.8046	0.6443	0.4713	0.5286	0.7725	0.9270	0.9739	0.9861	(94)
Useful gains	533.6856	616.0478	688.7818	742.4764	720.8982	571.7063	397.5046	409.1148	537.1557	557.5461	518.8740	504.5558	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1731.5977	1684.4402	1533.2126	1283.8224	994.1469	659.0405	419.2842	441.1761	704.1274	1065.2710	1415.4613	1715.3719	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	891.2466	717.9597	628.2565	389.7691	203.2971	0.0000	0.0000	0.0000	0.0000	377.7473	645.5428	900.8472	(98)
Space heating												4754.6663	(98)
Space heating per m2											(98) / (4) =	47.1787	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5253.7749	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	891.2466	717.9597	628.2565	389.7691	203.2971	0.0000	0.0000	0.0000	0.0000	377.7473	645.5428	900.8472	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	984.8029	793.3257	694.2061	430.6841	224.6377	0.0000	0.0000	0.0000	0.0000	417.4004	713.3070	995.4112	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9553	89.9159	89.8300	89.6262	89.1868	87.3000	87.3000	87.3000	87.3000	89.5820	89.8514	89.9733	(217)
Fuel for water heating, kWh/month													
	196.0382	171.9693	178.6673	157.5842	153.0393	136.5557	128.1658	144.7599	145.8047	163.6392	176.1935	190.2971	(219)
Water heating fuel used												1942.7143	(219)
Annual totals kWh/year													
Space heating fuel - main system												5253.7749	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												7702.6718	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5253.7749	0.2160	1134.8154	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.7143	0.2160	419.6263	(264)
Space and water heating			1554.4417	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/year			1817.1504	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0300	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		35.0105	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.0105	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	539.1184	616.8825	693.1714	775.2908	833.4163	821.9774	781.9754	723.5233	658.1885	581.0773	525.7569	510.5522	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9988	0.9974	0.9934	0.9785	0.9289	0.8034	0.6430	0.7046	0.9121	0.9874	0.9976	0.9991	(86)
MIT	19.5673	19.7123	19.9684	20.3279	20.6622	20.8951	20.9730	20.9585	20.7798	20.3535	19.9045	19.5517	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9983	0.9965	0.9909	0.9692	0.8957	0.7148	0.5034	0.5682	0.8570	0.9805	0.9965	0.9987	(89)
MIT 2	17.9705	18.1848	18.5606	19.0909	19.5550	19.8446	19.9095	19.9041	19.7214	19.1347	18.4775	17.9570	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9947	0.9872	0.9623	0.8897	0.7248	0.5275	0.5911	0.8564	0.9752	0.9948	0.9979	(94)
Useful gains	537.6747	613.5855	684.3288	746.0702	741.4647	595.7993	412.5302	427.6983	563.6486	566.6719	523.0059	509.5018	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1757.2657	1701.1671	1539.5380	1280.7310	987.4014	656.2952	422.5673	444.6968	705.9830	1073.1773	1435.3719	1744.0559	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating												4794.6907	(98)
Space heating per m2											(98) / (4) =	47.5758	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5133.5018	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	971.4943	782.4998	681.2373	412.1582	195.9068	0.0000	0.0000	0.0000	0.0000	403.4689	703.3228	983.4136	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2876	88.1330	87.7861	86.9721	85.2353	80.3000	80.3000	80.3000	80.3000	86.8241	87.8802	88.3479	(217)
Fuel for water heating, kWh/month													
	241.4382	213.1885	224.8054	201.9957	199.5525	186.5567	178.7355	199.2482	201.4487	211.3188	220.7179	235.4804	(219)
Water heating fuel used												2514.4865	(219)
Annual totals kWh/year													
Space heating fuel - main system												5133.5018	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8154.1709	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5133.5018	0.2160	1108.8364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2514.4865	0.2160	543.1291	(264)
Space and water heating			1651.9655	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1914.6742	(272)
Emissions per m2 for space and water heating			16.3918	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3918 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			19.0000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4040	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4040	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5152	0.5051	0.4950	0.4444	0.4343	0.3838	0.3838	0.3737	0.4040	0.4343	0.4545	0.4747	(22b)
Effective ac	0.6327	0.6275	0.6225	0.5988	0.5943	0.5737	0.5737	0.5698	0.5816	0.5943	0.6033	0.6127	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3927	53.9497	53.5155	51.4761	51.0946	49.3183	49.3183	48.9894	50.0025	51.0946	51.8665	52.6735	(38)
Heat transfer coeff	132.3518	131.9088	131.4746	129.4352	129.0536	127.2774	127.2774	126.9484	127.9615	129.0536	129.8255	130.6325	(39)
Average = Sum(39)m / 12 =												129.4334	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3133	1.3089	1.3046	1.2843	1.2805	1.2629	1.2629	1.2597	1.2697	1.2805	1.2882	1.2962	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	508.7810	600.1113	692.7231	794.7373	868.4953	862.0607	820.0174	748.1180	668.6997	572.3718	500.9029	478.5613	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7887	33.9022	34.0142	34.5501	34.6523	35.1359	35.1359	35.2269	34.9480	34.6523	34.4462	34.2334	
alpha	3.2526	3.2601	3.2676	3.3033	3.3102	3.3424	3.3424	3.3485	3.3299	3.3102	3.2964	3.2822	
util living area													
	0.9935	0.9883	0.9764	0.9446	0.8740	0.7474	0.6081	0.6673	0.8626	0.9650	0.9894	0.9947	(86)
MIT	18.8657	19.0816	19.4568	19.9718	20.4433	20.7842	20.9222	20.8925	20.6126	20.0032	19.3511	18.8394	(87)
Th 2	19.8305	19.8339	19.8373	19.8531	19.8561	19.8700	19.8700	19.8726	19.8646	19.8561	19.8501	19.8438	(88)
util rest of house													
	0.9920	0.9855	0.9703	0.9292	0.8357	0.6656	0.4802	0.5435	0.8052	0.9524	0.9864	0.9935	(89)
MIT 2	17.8889	18.1062	18.4806	18.9967	19.4437	19.7471	19.8416	19.8291	19.6126	19.0365	18.3873	17.8723	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0588	18.2758	18.6504	19.1663	19.6176	19.9275	20.0295	20.0141	19.7865	19.2046	18.5549	18.0405	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0588	18.2758	18.6504	19.1663	19.6176	19.9275	20.0295	20.0141	19.7865	19.2046	18.5549	18.0405	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9802	0.9620	0.9174	0.8261	0.6703	0.5000	0.5609	0.8004	0.9427	0.9815	0.9906	(94)
Useful gains	502.9608	588.2215	666.3971	729.0811	717.4635	577.8731	409.9737	419.6127	535.2336	539.5631	491.6225	474.0619	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1821.0020	1764.3913	1597.4663	1328.8171	1021.7898	678.0692	436.5031	458.8023	727.6568	1110.4603	1487.1445	1808.0195	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	980.6226	790.3861	692.7155	431.8099	226.4188	0.0000	0.0000	0.0000	0.0000	424.7475	716.7758	992.4645	(98)
Space heating												5255.9408	(98)
Space heating per m2											(98) / (4) =	52.1526	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1196.4072	941.8525	964.8080	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7414	0.8137	0.7762	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	887.0461	766.3848	748.8492	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.7326	1062.3591	980.3929	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	163.2143	220.2049	172.2685	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												555.6877	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	40.8036	55.0512	43.0671	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												138.9219	(107)
Space cooling per m2												1.3785	(108)
Energy for space heating												52.1526	(99)
Energy for space cooling												1.3785	(108)
Total												53.5311	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	492.8337	571.4267	649.4370	734.3343	794.6602	786.0417	747.8580	686.3951	619.5514	539.5803	481.5249	465.0929	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9992	0.9981	0.9950	0.9826	0.9391	0.8228	0.6660	0.7312	0.9273	0.9907	0.9983	0.9994	(86)
MIT	19.5251	19.6711	19.9295	20.2938	20.6366	20.8826	20.9686	20.9511	20.7560	20.3174	19.8642	19.5102	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9989	0.9975	0.9930	0.9749	0.9094	0.7372	0.5244	0.5947	0.8785	0.9854	0.9976	0.9992	(89)
MIT 2	18.5342	18.6827	18.9429	19.3158	19.6445	19.8611	19.9115	19.9073	19.7645	19.3444	18.8888	18.5299	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9966	0.9911	0.9710	0.9064	0.7480	0.5493	0.6182	0.8798	0.9827	0.9968	0.9988	(94)
Useful gains	492.0532	569.4704	643.6664	713.0159	720.2874	587.9912	410.7625	424.2999	545.0681	530.2390	479.9888	464.5416	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1815.0152	1751.9102	1578.2048	1302.8707	995.9211	657.6752	422.6736	444.8611	709.8069	1093.6613	1476.4482	1801.9653	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	984.2838	794.5996	695.2966	424.6954	205.0714	0.0000	0.0000	0.0000	0.0000	419.1862	717.4507	995.0433	(98)
Space heating												5235.6270	(98)
Space heating per m2											(98) / (4) =	51.9511	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7837	0.8640	0.8258	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	890.8440	773.0934	756.8898	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1024.8793	978.0170	908.2493	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	96.5054	152.4631	112.6114	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												361.5799	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	24.1264	38.1158	28.1529	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												90.3950 (107)
Space cooling per m2												0.8970 (108)
Energy for space heating												51.9511 (99)
Energy for space cooling												0.8970 (108)
Total												52.8480 (109)
Target Fabric Energy Efficiency (TFEE)												60.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	40.4699	0.4600	0.0000	0.7700	91.1671	(77)
Northwest	5.0200	12.9236	0.4600	0.0000	0.7700	22.9792	(81)
Northwest	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(81)

Solar gains	129.3894	210.0780	314.8290	455.1562	543.4766	599.1904	562.4923	491.1881	388.3691	256.9050	161.2054	108.1417	(83)
Total gains	764.2808	839.8331	919.6285	1021.3439	1069.9993	1090.4941	1033.4829	971.4835	891.1431	798.5180	745.8544	725.4751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9759	0.9659	0.9404	0.8770	0.7521	0.5374	0.3715	0.4031	0.6912	0.8960	0.9605	0.9790	(86)
MIT	19.3329	19.5107	19.8720	20.3338	20.7213	20.9399	20.9876	20.9839	20.8492	20.3893	19.8092	19.3149	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9704	0.9581	0.9261	0.8463	0.6886	0.4325	0.2408	0.2677	0.5964	0.8629	0.9498	0.9742	(89)
MIT 2	17.6743	17.9342	18.4511	19.0992	19.5990	19.8391	19.8689	19.8730	19.7619	19.1929	18.3778	17.6567	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9628	18.2084	18.6983	19.3139	19.7942	20.0306	20.0635	20.0663	19.9510	19.4010	18.6268	17.9452	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8128	18.0584	18.5483	19.1639	19.6442	19.8806	19.9135	19.9163	19.8010	19.2510	18.4768	17.7952	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9409	0.9043	0.8230	0.6747	0.4331	0.2457	0.2726	0.5894	0.8396	0.9313	0.9612	(94)
Useful gains	730.6912	790.1666	831.6043	840.5608	721.8951	472.3036	253.9597	264.7973	525.2025	670.4463	694.6449	697.2947	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1655.4736	1611.5984	1442.1233	1187.1121	851.4111	491.5598	255.7605	267.3445	582.8189	974.6303	1334.5934	1631.8107	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating												3422.4990	(98)
RHI space heating demand												3422	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9802	0.9704	0.9505	0.9038	0.8143	0.6695	0.5263	0.5746	0.7813	0.9239	0.9699	0.9829	(86)
MIT	19.1175	19.3234	19.6744	20.1500	20.5624	20.8450	20.9484	20.9305	20.7228	20.1984	19.5889	19.0933	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9757	0.9638	0.9389	0.8801	0.7662	0.5833	0.4062	0.4549	0.7090	0.9001	0.9620	0.9791	(89)
MIT 2	17.3410	17.6409	18.1478	18.8309	19.3864	19.7374	19.8342	19.8250	19.6066	18.9135	18.0403	17.3157	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6500	17.9336	18.4134	19.0603	19.5910	19.9301	20.0280	20.0173	19.8007	19.1370	18.3097	17.6249	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5000	17.7836	18.2634	18.9103	19.4410	19.7801	19.8780	19.8673	19.6507	18.9870	18.1597	17.4749	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9474	0.9179	0.8559	0.7464	0.5766	0.4083	0.4554	0.6938	0.8766	0.9455	0.9674	(94)
Useful gains	723.1797	794.7343	844.8220	861.4802	794.7515	602.7796	407.0583	423.5969	597.4085	684.3446	686.3460	692.1969	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1777.0196	1727.5725	1571.2393	1312.6051	1011.4936	665.8346	421.3500	444.3104	718.0304	1095.9068	1455.3783	1759.7322	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating												4091.5967	(98)
Space heating per m2											(98) / (4) =	40.5993	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4521.1013	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	866.3612	692.6710	597.1873	358.9060	178.1836	0.0000	0.0000	0.0000	0.0000	338.3451	611.8268	877.6201	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8950	89.8484	89.7468	89.5057	89.0044	87.3000	87.3000	87.3000	87.3000	89.4386	89.7684	89.9155	(217)
Fuel for water heating, kWh/month													
	196.1699	172.0986	178.8330	157.7963	153.3529	136.5557	128.1658	144.7599	145.8047	163.9015	176.3564	190.4194	(219)
Water heating fuel used												1944.2141	(219)
Annual totals kWh/year													
Space heating fuel - main system												4521.1013	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6971.4980	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4521.1013	3.4800	157.3343	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.2141	3.4800	67.6587	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Total energy cost			411.7585	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1863	(257)
SAP value		83.4511	
SAP rating (Section 12)		83	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4521.1013	0.2160	976.5579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.2141	0.2160	419.9503	(264)
Space and water heating			1396.5081	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1659.2169	(272)
CO2 emissions per m2			16.4600	(273)
EI value			84.7486	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8886 = 3.916, stars = 4
Water heating environmental impact	0.216 / 0.8886 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	40.4699	0.4600	0.0000	0.7700	91.1671	(77)
Northwest	5.0200	12.9236	0.4600	0.0000	0.7700	22.9792	(81)
Northwest	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(81)

Solar gains	129.3894	210.0780	314.8290	455.1562	543.4766	599.1904	562.4923	491.1881	388.3691	256.9050	161.2054	108.1417	(83)
Total gains	764.2808	839.8331	919.6285	1021.3439	1069.9993	1090.4941	1033.4829	971.4835	891.1431	798.5180	745.8544	725.4751	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9759	0.9659	0.9404	0.8770	0.7521	0.5374	0.3715	0.4031	0.6912	0.8960	0.9605	0.9790	(86)
MIT	19.3329	19.5107	19.8720	20.3338	20.7213	20.9399	20.9876	20.9839	20.8492	20.3893	19.8092	19.3149	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9704	0.9581	0.9261	0.8463	0.6886	0.4325	0.2408	0.2677	0.5964	0.8629	0.9498	0.9742	(89)
MIT 2	17.6743	17.9342	18.4511	19.0992	19.5990	19.8391	19.8689	19.8730	19.7619	19.1929	18.3778	17.6567	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9628	18.2084	18.6983	19.3139	19.7942	20.0306	20.0635	20.0663	19.9510	19.4010	18.6268	17.9452	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8128	18.0584	18.5483	19.1639	19.6442	19.8806	19.9135	19.9163	19.8010	19.2510	18.4768	17.7952	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9409	0.9043	0.8230	0.6747	0.4331	0.2457	0.2726	0.5894	0.8396	0.9313	0.9612	(94)
Useful gains	730.6912	790.1666	831.6043	840.5608	721.8951	472.3036	253.9597	264.7973	525.2025	670.4463	694.6449	697.2947	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1655.4736	1611.5984	1442.1233	1187.1121	851.4111	491.5598	255.7605	267.3445	582.8189	974.6303	1334.5934	1631.8107	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating												3422.4990	(98)
Space heating per m2											(98) / (4) =	33.9601	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3781.7669	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	760.2631	609.9471	501.9073	275.7094	106.4751	0.0000	0.0000	0.0000	0.0000	250.0695	509.1303	768.2650	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8282	89.7799	89.6421	89.3167	88.5964	87.3000	87.3000	87.3000	87.3000	89.2145	89.6596	89.8492	(217)
Fuel for water heating, kWh/month													
	196.3156	172.2299	179.0418	158.1303	154.0592	136.5557	128.1658	144.7599	145.8047	164.3133	176.5704	190.5599	(219)
Water heating fuel used												1946.5065	(219)
Annual totals kWh/year													
Space heating fuel - main system												3781.7669	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6234.4560	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3781.7669	3.9200	148.2453	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.5065	3.9200	76.3031	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Total energy cost			398.3969	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3781.7669	0.2160	816.8616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.5065	0.2160	420.4454	(264)
Space and water heating			1237.3071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1500.0158	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3781.7669	1.2200	4613.7556	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.5065	1.2200	2374.7380	(264)
Space and water heating			6988.4936	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Primary energy kWh/year			8542.4740	(272)
Primary energy kWh/m2/year			84.7636	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 83
Current environmental impact rating:	B 85

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-189 kg (12.6%)
U Solar photovoltaic panels	+ 9.2	-£ 309	-947 kg (72.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.88 kg/m²	B 85	B 86
Solar photovoltaic panels	£309	9.39 kg/m²	A 94	A 95
Total Savings	£340	11.27 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£86	£94	-£8
Mains gas	£313	£273	£39
Space heating	£249	£249	£0
Water heating	£76	£46	£31
Lighting	£73	£73	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£399	£58	£340
Total cost of uses	£398	£59	£340
Delivered energy	62 kWh/m²	34 kWh/m²	27 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	4 kg/m²	11 kg/m²
Primary energy	85 kWh/m²	19 kWh/m²	66 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9802	0.9704	0.9505	0.9038	0.8143	0.6695	0.5263	0.5746	0.7813	0.9239	0.9699	0.9829	(86)
MIT	19.1175	19.3234	19.6744	20.1500	20.5624	20.8450	20.9484	20.9305	20.7228	20.1984	19.5889	19.0933	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9757	0.9638	0.9389	0.8801	0.7662	0.5833	0.4062	0.4549	0.7090	0.9001	0.9620	0.9791	(89)
MIT 2	17.3410	17.6409	18.1478	18.8309	19.3864	19.7374	19.8342	19.8250	19.6066	18.9135	18.0403	17.3157	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6500	17.9336	18.4134	19.0603	19.5910	19.9301	20.0280	20.0173	19.8007	19.1370	18.3097	17.6249	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5000	17.7836	18.2634	18.9103	19.4410	19.7801	19.8780	19.8673	19.6507	18.9870	18.1597	17.4749	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9474	0.9179	0.8559	0.7464	0.5766	0.4083	0.4554	0.6938	0.8766	0.9455	0.9674	(94)
Useful gains	723.1797	794.7343	844.8220	861.4802	794.7515	602.7796	407.0583	423.5969	597.4085	684.3446	686.3460	692.1969	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1777.0196	1727.5725	1571.2393	1312.6051	1011.4936	665.8346	421.3500	444.3104	718.0304	1095.9068	1455.3783	1759.7322	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating												4091.5967	(98)
Space heating per m2											(98) / (4) =	40.5993	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4521.1013	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	866.3612	692.6710	597.1873	358.9060	178.1836	0.0000	0.0000	0.0000	0.0000	338.3451	611.8268	877.6201	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9671	89.9979	90.0342	90.0967	90.1710	87.3000	87.3000	87.3000	87.3000	89.7350	89.8798	89.9757	(217)
Fuel for water heating, kWh/month	167.9817	125.0532	98.6573	50.1492	19.7672	2.9152	0.0000	29.5406	55.5649	103.4092	142.8567	166.8371	(219)
Water heating fuel used												962.7324	(219)
Annual totals kWh/year													
Space heating fuel - main system												4521.1013	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4312.7768	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4521.1013	3.4800	157.3343	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.7324	3.4800	33.5031	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			156.3750	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4505	(257)
SAP value	93.7152	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4521.1013	0.2160	976.5579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.7324	0.2160	207.9502	(264)
Space and water heating			1184.5081	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			576.7296	(272)
CO2 emissions per m2			5.7200	(273)
EI value			94.6987	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2243	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-887.0104	(H17)
Solar input	-27.3017	-41.0345	-69.1072	-95.5273	-115.0470	-121.0820	-118.1746	-105.5306	-82.3670	-56.0328	-33.1860	-22.6197	(63)
								Solar input (sum of months) = Sum(63)m =				-887.0104	(63)
Output from w/h													
	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
								Total per year (kWh/year) = Sum(64)m =				851.2283	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	40.4699	0.4600	0.0000	0.7700	91.1671	(77)
Northwest	5.0200	12.9236	0.4600	0.0000	0.7700	22.9792	(81)
Northwest	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(81)

Solar gains	129.3894	210.0780	314.8290	455.1562	543.4766	599.1904	562.4923	491.1881	388.3691	256.9050	161.2054	108.1417	(83)
Total gains	764.2808	839.8331	919.6285	1021.3439	1069.9993	1090.4941	1033.4829	971.4835	891.1431	798.5180	745.8544	725.4751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9759	0.9659	0.9404	0.8770	0.7521	0.5374	0.3715	0.4031	0.6912	0.8960	0.9605	0.9790	(86)
MIT	19.3329	19.5107	19.8720	20.3338	20.7213	20.9399	20.9876	20.9839	20.8492	20.3893	19.8092	19.3149	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9704	0.9581	0.9261	0.8463	0.6886	0.4325	0.2408	0.2677	0.5964	0.8629	0.9498	0.9742	(89)
MIT 2	17.6743	17.9342	18.4511	19.0992	19.5990	19.8391	19.8689	19.8730	19.7619	19.1929	18.3778	17.6567	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9628	18.2084	18.6983	19.3139	19.7942	20.0306	20.0635	20.0663	19.9510	19.4010	18.6268	17.9452	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8128	18.0584	18.5483	19.1639	19.6442	19.8806	19.9135	19.9163	19.8010	19.2510	18.4768	17.7952	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9409	0.9043	0.8230	0.6747	0.4331	0.2457	0.2726	0.5894	0.8396	0.9313	0.9612	(94)
Useful gains	730.6912	790.1666	831.6043	840.5608	721.8951	472.3036	253.9597	264.7973	525.2025	670.4463	694.6449	697.2947	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1655.4736	1611.5984	1442.1233	1187.1121	851.4111	491.5598	255.7605	267.3445	582.8189	974.6303	1334.5934	1631.8107	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating												3422.4990	(98)
Space heating per m2											(98) / (4) =	33.9601	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3781.7669	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	760.2631	609.9471	501.9073	275.7094	106.4751	0.0000	0.0000	0.0000	0.0000	250.0695	509.1303	768.2650	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9132	89.9374	89.9477	89.9893	89.9002	87.3000	87.3000	87.3000	87.3000	89.5618	89.7970	89.9196	(217)
Fuel for water heating, kWh/month	165.7656	126.3027	101.6030	50.7942	23.8530	0.0000	0.0000	23.8772	51.4554	101.1129	139.3434	165.2553	(219)
Water heating fuel used												949.3627	(219)

Annual totals kWh/year		
Space heating fuel - main system	3781.7669	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	3463.1525	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3781.7669	3.9200	148.2453	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	949.3627	3.9200	37.2150	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			58.4114	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3781.7669	0.2160	816.8616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.3627	0.2160	205.0623	(264)
Space and water heating			1021.9240	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			363.8439 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3781.7669	1.2200	4613.7556	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.3627	1.2200	1158.2225	(264)
Space and water heating			5771.9781	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1879.2884	(272)
Primary energy kWh/m2/year			18.6474	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		343.88 (P1)
Transmission heat loss coefficient		77.96 (37)
Summer heat loss coefficient		421.84 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	6.3600	119.9223	0.4600	0.0000	0.9000	315.7603
North West	5.0200	98.8453	0.4600	0.0000	0.9000	205.4281
North West	3.3300	98.8453	0.4600	0.0000	0.9000	136.2701
total:						657.4586

	Jun	Jul	Aug	
Solar gains	700	657	574	(P4)
Internal gains	488	468	477	
Total summer gains	1189	1125	1051	(P5)
Summer gain/loss ratio	2.82	2.67	2.49	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.70	21.45	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-324	**Issued on Date**	19/10/2022
Assessment Reference	Plot 324	**Prop Type Ref**	Islington-As-DET
Property	Plot 324, 3 Bed, K, WC, Ut, B, En		

SAP Rating	83 B	**DER**	18.03	**TER**	19.00
Environmental	85 B	**% DER<TER**	5.10		
CO_2 Emissions (t/year)	1.50	**DFEE**	53.53	**TFEE**	60.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.92		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.00 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.03 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 6.36 m², No overhang
Windows facing North West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	542.6957	633.1929	724.0748	823.7343	895.9616	887.3742	843.5044	773.9488	695.3660	601.4748	532.7547	511.6465	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9921	0.9864	0.9735	0.9401	0.8674	0.7386	0.5992	0.6556	0.8530	0.9604	0.9873	0.9935	(86)
MIT	18.8712	19.0872	19.4623	19.9801	20.4493	20.7887	20.9240	20.8962	20.6224	20.0178	19.3655	18.8493	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9902	0.9831	0.9668	0.9236	0.8276	0.6555	0.4710	0.5311	0.7931	0.9463	0.9837	0.9920	(89)
MIT 2	16.9845	17.3013	17.8479	18.6009	19.2495	19.6853	19.8199	19.8026	19.4976	18.6677	17.7201	16.9620	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3126	17.6119	18.1287	18.8408	19.4582	19.8772	20.0120	19.9928	19.6932	18.9025	18.0063	17.2903	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1626	17.4619	17.9787	18.6908	19.3082	19.7272	19.8620	19.8428	19.5432	18.7525	17.8563	17.1403	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9729	0.9513	0.9014	0.8046	0.6443	0.4713	0.5286	0.7725	0.9270	0.9739	0.9861	(94)
Useful gains	533.6856	616.0478	688.7818	742.4764	720.8982	571.7063	397.5046	409.1148	537.1557	557.5461	518.8740	504.5558	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1731.5977	1684.4402	1533.2126	1283.8224	994.1469	659.0405	419.2842	441.1761	704.1274	1065.2710	1415.4613	1715.3719	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	891.2466	717.9597	628.2565	389.7691	203.2971	0.0000	0.0000	0.0000	0.0000	377.7473	645.5428	900.8472	(98)
Space heating												4754.6663	(98)
Space heating per m2											(98) / (4) =	47.1787	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5253.7749	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	891.2466	717.9597	628.2565	389.7691	203.2971	0.0000	0.0000	0.0000	0.0000	377.7473	645.5428	900.8472	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	984.8029	793.3257	694.2061	430.6841	224.6377	0.0000	0.0000	0.0000	0.0000	417.4004	713.3070	995.4112	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9553	89.9159	89.8300	89.6262	89.1868	87.3000	87.3000	87.3000	87.3000	89.5820	89.8514	89.9733	(217)
Fuel for water heating, kWh/month													
	196.0382	171.9693	178.6673	157.5842	153.0393	136.5557	128.1658	144.7599	145.8047	163.6392	176.1935	190.2971	(219)
Water heating fuel used												1942.7143	(219)
Annual totals kWh/year													
Space heating fuel - main system												5253.7749	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												7702.6718	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5253.7749	0.2160	1134.8154	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.7143	0.2160	419.6263	(264)
Space and water heating			1554.4417	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/year			1817.1504	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0300	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		35.0105	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.0105	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	539.1184	616.8825	693.1714	775.2908	833.4163	821.9774	781.9754	723.5233	658.1885	581.0773	525.7569	510.5522	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9988	0.9974	0.9934	0.9785	0.9289	0.8034	0.6430	0.7046	0.9121	0.9874	0.9976	0.9991	(86)
MIT	19.5673	19.7123	19.9684	20.3279	20.6622	20.8951	20.9730	20.9585	20.7798	20.3535	19.9045	19.5517	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9983	0.9965	0.9909	0.9692	0.8957	0.7148	0.5034	0.5682	0.8570	0.9805	0.9965	0.9987	(89)
MIT 2	17.9705	18.1848	18.5606	19.0909	19.5550	19.8446	19.9095	19.9041	19.7214	19.1347	18.4775	17.9570	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2482	18.4505	18.8055	19.3060	19.7476	20.0274	20.0945	20.0875	19.9055	19.3467	18.7257	18.2344	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9947	0.9872	0.9623	0.8897	0.7248	0.5275	0.5911	0.8564	0.9752	0.9948	0.9979	(94)
Useful gains	537.6747	613.5855	684.3288	746.0702	741.4647	595.7993	412.5302	427.6983	563.6486	566.6719	523.0059	509.5018	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1757.2657	1701.1671	1539.5380	1280.7310	987.4014	656.2952	422.5673	444.6968	705.9830	1073.1773	1435.3719	1744.0559	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating												4794.6907	(98)
Space heating per m2											(98) / (4) =	47.5758	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5133.5018	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	907.3757	730.8549	636.2756	384.9558	182.9769	0.0000	0.0000	0.0000	0.0000	376.8400	656.9035	918.5083	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	971.4943	782.4998	681.2373	412.1582	195.9068	0.0000	0.0000	0.0000	0.0000	403.4689	703.3228	983.4136	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2876	88.1330	87.7861	86.9721	85.2353	80.3000	80.3000	80.3000	80.3000	86.8241	87.8802	88.3479	(217)
Fuel for water heating, kWh/month													
	241.4382	213.1885	224.8054	201.9957	199.5525	186.5567	178.7355	199.2482	201.4487	211.3188	220.7179	235.4804	(219)
Water heating fuel used												2514.4865	(219)
Annual totals kWh/year													
Space heating fuel - main system												5133.5018	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8154.1709	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5133.5018	0.2160	1108.8364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2514.4865	0.2160	543.1291	(264)
Space and water heating			1651.9655	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1914.6742	(272)
Emissions per m2 for space and water heating			16.3918	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3918 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			19.0000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4040	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4040	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5152	0.5051	0.4950	0.4444	0.4343	0.3838	0.3838	0.3737	0.4040	0.4343	0.4545	0.4747	(22b)
Effective ac	0.6327	0.6275	0.6225	0.5988	0.5943	0.5737	0.5737	0.5698	0.5816	0.5943	0.6033	0.6127	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3927	53.9497	53.5155	51.4761	51.0946	49.3183	49.3183	48.9894	50.0025	51.0946	51.8665	52.6735	(38)
Heat transfer coeff	132.3518	131.9088	131.4746	129.4352	129.0536	127.2774	127.2774	126.9484	127.9615	129.0536	129.8255	130.6325	(39)
Average = Sum(39)m / 12 =												129.4334	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3133	1.3089	1.3046	1.2843	1.2805	1.2629	1.2629	1.2597	1.2697	1.2805	1.2882	1.2962	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	508.7810	600.1113	692.7231	794.7373	868.4953	862.0607	820.0174	748.1180	668.6997	572.3718	500.9029	478.5613	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7887	33.9022	34.0142	34.5501	34.6523	35.1359	35.1359	35.2269	34.9480	34.6523	34.4462	34.2334	
alpha	3.2526	3.2601	3.2676	3.3033	3.3102	3.3424	3.3424	3.3485	3.3299	3.3102	3.2964	3.2822	
util living area													
	0.9935	0.9883	0.9764	0.9446	0.8740	0.7474	0.6081	0.6673	0.8626	0.9650	0.9894	0.9947	(86)
MIT	18.8657	19.0816	19.4568	19.9718	20.4433	20.7842	20.9222	20.8925	20.6126	20.0032	19.3511	18.8394	(87)
Th 2	19.8305	19.8339	19.8373	19.8531	19.8561	19.8700	19.8700	19.8726	19.8646	19.8561	19.8501	19.8438	(88)
util rest of house													
	0.9920	0.9855	0.9703	0.9292	0.8357	0.6656	0.4802	0.5435	0.8052	0.9524	0.9864	0.9935	(89)
MIT 2	17.8889	18.1062	18.4806	18.9967	19.4437	19.7471	19.8416	19.8291	19.6126	19.0365	18.3873	17.8723	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0588	18.2758	18.6504	19.1663	19.6176	19.9275	20.0295	20.0141	19.7865	19.2046	18.5549	18.0405	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0588	18.2758	18.6504	19.1663	19.6176	19.9275	20.0295	20.0141	19.7865	19.2046	18.5549	18.0405	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9802	0.9620	0.9174	0.8261	0.6703	0.5000	0.5609	0.8004	0.9427	0.9815	0.9906	(94)
Useful gains	502.9608	588.2215	666.3971	729.0811	717.4635	577.8731	409.9737	419.6127	535.2336	539.5631	491.6225	474.0619	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1821.0020	1764.3913	1597.4663	1328.8171	1021.7898	678.0692	436.5031	458.8023	727.6568	1110.4603	1487.1445	1808.0195	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	980.6226	790.3861	692.7155	431.8099	226.4188	0.0000	0.0000	0.0000	0.0000	424.7475	716.7758	992.4645	(98)
Space heating												5255.9408	(98)
Space heating per m2											(98) / (4) =	52.1526	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1196.4072	941.8525	964.8080	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7414	0.8137	0.7762	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	887.0461	766.3848	748.8492	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1113.7326	1062.3591	980.3929	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	163.2143	220.2049	172.2685	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												555.6877	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	40.8036	55.0512	43.0671	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												138.9219	(107)
Space cooling per m2												1.3785	(108)
Energy for space heating												52.1526	(99)
Energy for space cooling												1.3785	(108)
Total												53.5311	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.6300	0.7000	0.7700	71.5161	(77)
Northwest	8.3500	11.2829	0.6300	0.7000	0.7700	28.7926	(81)

Solar gains	100.3087	180.4266	272.2705	379.9356	464.4240	478.1606	453.8837	388.2380	309.1432	206.2591	121.8884	84.7164	(83)
Total gains	492.8337	571.4267	649.4370	734.3343	794.6602	786.0417	747.8580	686.3951	619.5514	539.5803	481.5249	465.0929	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9992	0.9981	0.9950	0.9826	0.9391	0.8228	0.6660	0.7312	0.9273	0.9907	0.9983	0.9994	(86)
MIT	19.5251	19.6711	19.9295	20.2938	20.6366	20.8826	20.9686	20.9511	20.7560	20.3174	19.8642	19.5102	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9989	0.9975	0.9930	0.9749	0.9094	0.7372	0.5244	0.5947	0.8785	0.9854	0.9976	0.9992	(89)
MIT 2	18.5342	18.6827	18.9429	19.3158	19.6445	19.8611	19.9115	19.9073	19.7645	19.3444	18.8888	18.5299	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7066	18.8547	19.1145	19.4859	19.8170	20.0388	20.0954	20.0889	19.9370	19.5137	19.0584	18.7004	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9966	0.9911	0.9710	0.9064	0.7480	0.5493	0.6182	0.8798	0.9827	0.9968	0.9988	(94)
Useful gains	492.0532	569.4704	643.6664	713.0159	720.2874	587.9912	410.7625	424.2999	545.0681	530.2390	479.9888	464.5416	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1815.0152	1751.9102	1578.2048	1302.8707	995.9211	657.6752	422.6736	444.8611	709.8069	1093.6613	1476.4482	1801.9653	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	984.2838	794.5996	695.2966	424.6954	205.0714	0.0000	0.0000	0.0000	0.0000	419.1862	717.4507	995.0433	(98)
Space heating												5235.6270	(98)
Space heating per m2											(98) / (4) =	51.9511	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7837	0.8640	0.8258	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	890.8440	773.0934	756.8898	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1024.8793	978.0170	908.2493	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	96.5054	152.4631	112.6114	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												361.5799	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	24.1264	38.1158	28.1529	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												90.3950 (107)
Space cooling per m2												0.8970 (108)
Energy for space heating												51.9511 (99)
Energy for space cooling												0.8970 (108)
Total												52.8480 (109)
Target Fabric Energy Efficiency (TFEE)												60.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	40.4699	0.4600	0.0000	0.7700	91.1671	(77)
Northwest	5.0200	12.9236	0.4600	0.0000	0.7700	22.9792	(81)
Northwest	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(81)

Solar gains	129.3894	210.0780	314.8290	455.1562	543.4766	599.1904	562.4923	491.1881	388.3691	256.9050	161.2054	108.1417	(83)
Total gains	764.2808	839.8331	919.6285	1021.3439	1069.9993	1090.4941	1033.4829	971.4835	891.1431	798.5180	745.8544	725.4751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9759	0.9659	0.9404	0.8770	0.7521	0.5374	0.3715	0.4031	0.6912	0.8960	0.9605	0.9790	(86)
MIT	19.3329	19.5107	19.8720	20.3338	20.7213	20.9399	20.9876	20.9839	20.8492	20.3893	19.8092	19.3149	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9704	0.9581	0.9261	0.8463	0.6886	0.4325	0.2408	0.2677	0.5964	0.8629	0.9498	0.9742	(89)
MIT 2	17.6743	17.9342	18.4511	19.0992	19.5990	19.8391	19.8689	19.8730	19.7619	19.1929	18.3778	17.6567	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9628	18.2084	18.6983	19.3139	19.7942	20.0306	20.0635	20.0663	19.9510	19.4010	18.6268	17.9452	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8128	18.0584	18.5483	19.1639	19.6442	19.8806	19.9135	19.9163	19.8010	19.2510	18.4768	17.7952	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9409	0.9043	0.8230	0.6747	0.4331	0.2457	0.2726	0.5894	0.8396	0.9313	0.9612	(94)
Useful gains	730.6912	790.1666	831.6043	840.5608	721.8951	472.3036	253.9597	264.7973	525.2025	670.4463	694.6449	697.2947	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1655.4736	1611.5984	1442.1233	1187.1121	851.4111	491.5598	255.7605	267.3445	582.8189	974.6303	1334.5934	1631.8107	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating												3422.4990	(98)
RHI space heating demand												3422	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9802	0.9704	0.9505	0.9038	0.8143	0.6695	0.5263	0.5746	0.7813	0.9239	0.9699	0.9829	(86)
MIT	19.1175	19.3234	19.6744	20.1500	20.5624	20.8450	20.9484	20.9305	20.7228	20.1984	19.5889	19.0933	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9757	0.9638	0.9389	0.8801	0.7662	0.5833	0.4062	0.4549	0.7090	0.9001	0.9620	0.9791	(89)
MIT 2	17.3410	17.6409	18.1478	18.8309	19.3864	19.7374	19.8342	19.8250	19.6066	18.9135	18.0403	17.3157	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6500	17.9336	18.4134	19.0603	19.5910	19.9301	20.0280	20.0173	19.8007	19.1370	18.3097	17.6249	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5000	17.7836	18.2634	18.9103	19.4410	19.7801	19.8780	19.8673	19.6507	18.9870	18.1597	17.4749	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9474	0.9179	0.8559	0.7464	0.5766	0.4083	0.4554	0.6938	0.8766	0.9455	0.9674	(94)
Useful gains	723.1797	794.7343	844.8220	861.4802	794.7515	602.7796	407.0583	423.5969	597.4085	684.3446	686.3460	692.1969	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1777.0196	1727.5725	1571.2393	1312.6051	1011.4936	665.8346	421.3500	444.3104	718.0304	1095.9068	1455.3783	1759.7322	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating												4091.5967	(98)
Space heating per m2											(98) / (4) =	40.5993	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4521.1013	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	866.3612	692.6710	597.1873	358.9060	178.1836	0.0000	0.0000	0.0000	0.0000	338.3451	611.8268	877.6201	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8950	89.8484	89.7468	89.5057	89.0044	87.3000	87.3000	87.3000	87.3000	89.4386	89.7684	89.9155	(217)
Fuel for water heating, kWh/month													
	196.1699	172.0986	178.8330	157.7963	153.3529	136.5557	128.1658	144.7599	145.8047	163.9015	176.3564	190.4194	(219)
Water heating fuel used												1944.2141	(219)
Annual totals kWh/year													
Space heating fuel - main system												4521.1013	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6971.4980	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4521.1013	3.4800	157.3343	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.2141	3.4800	67.6587	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Total energy cost			411.7585	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1863	(257)
SAP value		83.4511	
SAP rating (Section 12)		83	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4521.1013	0.2160	976.5579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.2141	0.2160	419.9503	(264)
Space and water heating			1396.5081	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1659.2169	(272)
CO2 emissions per m2			16.4600	(273)
EI value			84.7486	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8886 = 3.916, stars = 4
Water heating environmental impact	0.216 / 0.8886 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	40.4699	0.4600	0.0000	0.7700	91.1671	(77)
Northwest	5.0200	12.9236	0.4600	0.0000	0.7700	22.9792	(81)
Northwest	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(81)

Solar gains	129.3894	210.0780	314.8290	455.1562	543.4766	599.1904	562.4923	491.1881	388.3691	256.9050	161.2054	108.1417	(83)
Total gains	764.2808	839.8331	919.6285	1021.3439	1069.9993	1090.4941	1033.4829	971.4835	891.1431	798.5180	745.8544	725.4751	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9759	0.9659	0.9404	0.8770	0.7521	0.5374	0.3715	0.4031	0.6912	0.8960	0.9605	0.9790	(86)
MIT	19.3329	19.5107	19.8720	20.3338	20.7213	20.9399	20.9876	20.9839	20.8492	20.3893	19.8092	19.3149	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9704	0.9581	0.9261	0.8463	0.6886	0.4325	0.2408	0.2677	0.5964	0.8629	0.9498	0.9742	(89)
MIT 2	17.6743	17.9342	18.4511	19.0992	19.5990	19.8391	19.8689	19.8730	19.7619	19.1929	18.3778	17.6567	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9628	18.2084	18.6983	19.3139	19.7942	20.0306	20.0635	20.0663	19.9510	19.4010	18.6268	17.9452	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8128	18.0584	18.5483	19.1639	19.6442	19.8806	19.9135	19.9163	19.8010	19.2510	18.4768	17.7952	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9409	0.9043	0.8230	0.6747	0.4331	0.2457	0.2726	0.5894	0.8396	0.9313	0.9612	(94)
Useful gains	730.6912	790.1666	831.6043	840.5608	721.8951	472.3036	253.9597	264.7973	525.2025	670.4463	694.6449	697.2947	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1655.4736	1611.5984	1442.1233	1187.1121	851.4111	491.5598	255.7605	267.3445	582.8189	974.6303	1334.5934	1631.8107	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating												3422.4990	(98)
Space heating per m2											(98) / (4) =	33.9601	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3781.7669	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	760.2631	609.9471	501.9073	275.7094	106.4751	0.0000	0.0000	0.0000	0.0000	250.0695	509.1303	768.2650	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8282	89.7799	89.6421	89.3167	88.5964	87.3000	87.3000	87.3000	87.3000	89.2145	89.6596	89.8492	(217)
Fuel for water heating, kWh/month													
	196.3156	172.2299	179.0418	158.1303	154.0592	136.5557	128.1658	144.7599	145.8047	164.3133	176.5704	190.5599	(219)
Water heating fuel used												1946.5065	(219)
Annual totals kWh/year													
Space heating fuel - main system												3781.7669	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6234.4560	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3781.7669	3.9200	148.2453	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.5065	3.9200	76.3031	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Total energy cost			398.3969	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3781.7669	0.2160	816.8616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.5065	0.2160	420.4454	(264)
Space and water heating			1237.3071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1500.0158	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3781.7669	1.2200	4613.7556	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.5065	1.2200	2374.7380	(264)
Space and water heating			6988.4936	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Primary energy kWh/year			8542.4740	(272)
Primary energy kWh/m2/year			84.7636	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 83
Current environmental impact rating:	B 85

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-189 kg (12.6%)
U Solar photovoltaic panels	+ 9.2	-£ 309	-947 kg (72.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.88 kg/m²	B 85	B 86
Solar photovoltaic panels	£309	9.39 kg/m²	A 94	A 95
Total Savings	£340	11.27 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£86	£94	-£8
Mains gas	£313	£273	£39
Space heating	£249	£249	£0
Water heating	£76	£46	£31
Lighting	£73	£73	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£399	£58	£340
Total cost of uses	£398	£59	£340
Delivered energy	62 kWh/m²	34 kWh/m²	27 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	4 kg/m²	11 kg/m²
Primary energy	85 kWh/m²	19 kWh/m²	66 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	36.7938	0.4600	0.0000	0.7700	82.8859	(77)
Northwest	5.0200	11.2829	0.4600	0.0000	0.7700	20.0620	(81)
Northwest	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(81)

Solar gains	116.2560	209.1111	315.5566	440.3386	538.2591	554.1796	526.0430	449.9609	358.2915	239.0506	141.2664	98.1848	(83)
Total gains	751.1474	838.8663	920.3561	1006.5264	1064.7817	1045.4834	997.0337	930.2563	861.0655	780.6636	725.9154	715.5181	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9802	0.9704	0.9505	0.9038	0.8143	0.6695	0.5263	0.5746	0.7813	0.9239	0.9699	0.9829	(86)
MIT	19.1175	19.3234	19.6744	20.1500	20.5624	20.8450	20.9484	20.9305	20.7228	20.1984	19.5889	19.0933	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9757	0.9638	0.9389	0.8801	0.7662	0.5833	0.4062	0.4549	0.7090	0.9001	0.9620	0.9791	(89)
MIT 2	17.3410	17.6409	18.1478	18.8309	19.3864	19.7374	19.8342	19.8250	19.6066	18.9135	18.0403	17.3157	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6500	17.9336	18.4134	19.0603	19.5910	19.9301	20.0280	20.0173	19.8007	19.1370	18.3097	17.6249	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5000	17.7836	18.2634	18.9103	19.4410	19.7801	19.8780	19.8673	19.6507	18.9870	18.1597	17.4749	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9474	0.9179	0.8559	0.7464	0.5766	0.4083	0.4554	0.6938	0.8766	0.9455	0.9674	(94)
Useful gains	723.1797	794.7343	844.8220	861.4802	794.7515	602.7796	407.0583	423.5969	597.4085	684.3446	686.3460	692.1969	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1777.0196	1727.5725	1571.2393	1312.6051	1011.4936	665.8346	421.3500	444.3104	718.0304	1095.9068	1455.3783	1759.7322	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating												4091.5967	(98)
Space heating per m2											(98) / (4) =	40.5993	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4521.1013	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	784.0569	626.8673	540.4545	324.8100	161.2562	0.0000	0.0000	0.0000	0.0000	306.2023	553.7033	794.2462	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	866.3612	692.6710	597.1873	358.9060	178.1836	0.0000	0.0000	0.0000	0.0000	338.3451	611.8268	877.6201	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9671	89.9979	90.0342	90.0967	90.1710	87.3000	87.3000	87.3000	87.3000	89.7350	89.8798	89.9757	(217)
Fuel for water heating, kWh/month	167.9817	125.0532	98.6573	50.1492	19.7672	2.9152	0.0000	29.5406	55.5649	103.4092	142.8567	166.8371	(219)
Water heating fuel used												962.7324	(219)
Annual totals kWh/year													
Space heating fuel - main system												4521.1013	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4312.7768	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4521.1013	3.4800	157.3343	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.7324	3.4800	33.5031	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			156.3750	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4505	(257)
SAP value	93.7152	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4521.1013	0.2160	976.5579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.7324	0.2160	207.9502	(264)
Space and water heating			1184.5081	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			576.7296	(272)
CO2 emissions per m2			5.7200	(273)
EI value			94.6987	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2243	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-887.0104	(H17)
Solar input	-27.3017	-41.0345	-69.1072	-95.5273	-115.0470	-121.0820	-118.1746	-105.5306	-82.3670	-56.0328	-33.1860	-22.6197	(63)
								Solar input (sum of months) = Sum(63)m =				-887.0104	(63)
Output from w/h													
	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
								Total per year (kWh/year) = Sum(64)m =				851.2283	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.3600	40.4699	0.4600	0.0000	0.7700	91.1671	(77)
Northwest	5.0200	12.9236	0.4600	0.0000	0.7700	22.9792	(81)
Northwest	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(81)

Solar gains	129.3894	210.0780	314.8290	455.1562	543.4766	599.1904	562.4923	491.1881	388.3691	256.9050	161.2054	108.1417	(83)
Total gains	764.2808	839.8331	919.6285	1021.3439	1069.9993	1090.4941	1033.4829	971.4835	891.1431	798.5180	745.8544	725.4751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9759	0.9659	0.9404	0.8770	0.7521	0.5374	0.3715	0.4031	0.6912	0.8960	0.9605	0.9790	(86)
MIT	19.3329	19.5107	19.8720	20.3338	20.7213	20.9399	20.9876	20.9839	20.8492	20.3893	19.8092	19.3149	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9704	0.9581	0.9261	0.8463	0.6886	0.4325	0.2408	0.2677	0.5964	0.8629	0.9498	0.9742	(89)
MIT 2	17.6743	17.9342	18.4511	19.0992	19.5990	19.8391	19.8689	19.8730	19.7619	19.1929	18.3778	17.6567	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9628	18.2084	18.6983	19.3139	19.7942	20.0306	20.0635	20.0663	19.9510	19.4010	18.6268	17.9452	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8128	18.0584	18.5483	19.1639	19.6442	19.8806	19.9135	19.9163	19.8010	19.2510	18.4768	17.7952	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9409	0.9043	0.8230	0.6747	0.4331	0.2457	0.2726	0.5894	0.8396	0.9313	0.9612	(94)
Useful gains	730.6912	790.1666	831.6043	840.5608	721.8951	472.3036	253.9597	264.7973	525.2025	670.4463	694.6449	697.2947	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1655.4736	1611.5984	1442.1233	1187.1121	851.4111	491.5598	255.7605	267.3445	582.8189	974.6303	1334.5934	1631.8107	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating												3422.4990	(98)
Space heating per m2											(98) / (4) =	33.9601	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3781.7669	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	688.0381	552.0022	454.2261	249.5170	96.3599	0.0000	0.0000	0.0000	0.0000	226.3129	460.7629	695.2798	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	760.2631	609.9471	501.9073	275.7094	106.4751	0.0000	0.0000	0.0000	0.0000	250.0695	509.1303	768.2650	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9132	89.9374	89.9477	89.9893	89.9002	87.3000	87.3000	87.3000	87.3000	89.5618	89.7970	89.9196	(217)
Fuel for water heating, kWh/month	165.7656	126.3027	101.6030	50.7942	23.8530	0.0000	0.0000	23.8772	51.4554	101.1129	139.3434	165.2553	(219)
Water heating fuel used												949.3627	(219)

Annual totals kWh/year		
Space heating fuel - main system	3781.7669	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	3463.1525	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3781.7669	3.9200	148.2453	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	949.3627	3.9200	37.2150	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			58.4114	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3781.7669	0.2160	816.8616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.3627	0.2160	205.0623	(264)
Space and water heating			1021.9240	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			363.8439 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3781.7669	1.2200	4613.7556	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.3627	1.2200	1158.2225	(264)
Space and water heating			5771.9781	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1879.2884	(272)
Primary energy kWh/m2/year			18.6474	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		343.88 (P1)
Transmission heat loss coefficient		77.96 (37)
Summer heat loss coefficient		421.84 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	6.3600	119.9223	0.4600	0.0000	0.9000	315.7603
North West	5.0200	98.8453	0.4600	0.0000	0.9000	205.4281
North West	3.3300	98.8453	0.4600	0.0000	0.9000	136.2701
total:						657.4586

	Jun	Jul	Aug	
Solar gains	700	657	574	(P4)
Internal gains	488	468	477	
Total summer gains	1189	1125	1051	(P5)
Summer gain/loss ratio	2.82	2.67	2.49	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.70	21.45	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-325	**Issued on Date**	19/10/2022
Assessment Reference	Plot 325	**Prop Type Ref**	Darwen-As-DET
Property	Plot 325, 4 Bed, K, WC, B, En		

SAP Rating	84 B	**DER**	16.77	**TER**	17.01
Environmental	85 B	**% DER<TER**	1.42		
CO_2 Emissions (t/year)	1.72	**DFEE**	50.78	**TFEE**	58.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.00		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 122 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.01 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.77 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 7.08 m², No overhang
Windows facing East: 1.03 m², No overhang
Windows facing South East: 6.50 m², No overhang
Windows facing South West: 8.16 m², No overhang
Windows facing West: 1.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.030 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3777	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4816	0.4722	0.4627	0.4155	0.4061	0.3588	0.3588	0.3494	0.3777	0.4061	0.4249	0.4438	(22b)
Effective ac	0.6160	0.6115	0.6070	0.5863	0.5824	0.5644	0.5644	0.5610	0.5713	0.5824	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9102	63.4430	62.9850	60.8339	60.4314	58.5579	58.5579	58.2109	59.2795	60.4314	61.2456	62.0968	(38)
Heat transfer coeff	160.7852	160.3180	159.8600	157.7089	157.3064	155.4329	155.4329	155.0860	156.1546	157.3064	158.1206	158.9718	(39)
Average = Sum(39)m / 12 =												157.7070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3217	1.3179	1.3141	1.2964	1.2931	1.2777	1.2777	1.2749	1.2836	1.2931	1.2998	1.3068	(40)
HLP (average)												1.2964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	506.1781	503.9041	487.1911	459.9822	431.8858	405.1596	388.0137	394.5683	408.7327	436.1753	467.7391	491.8640	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	739.8579	914.9690	1082.4022	1249.4493	1361.4475	1347.3493	1288.3746	1187.8330	1071.0095	899.5016	750.0490	690.2585	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.5292	31.6211	31.7117	32.1442	32.2265	32.6149	32.6149	32.6879	32.4642	32.2265	32.0605	31.8889	
alpha	3.1019	3.1081	3.1141	3.1429	3.1484	3.1743	3.1743	3.1792	3.1643	3.1484	3.1374	3.1259	
util living area													
	0.9866	0.9739	0.9480	0.8897	0.7855	0.6356	0.4949	0.5468	0.7621	0.9253	0.9771	0.9892	(86)
MIT	18.8893	19.1737	19.6026	20.1344	20.5720	20.8489	20.9495	20.9302	20.7153	20.1260	19.4096	18.8457	(87)
Th 2	19.8239	19.8269	19.8298	19.8436	19.8462	19.8583	19.8583	19.8606	19.8537	19.8462	19.8410	19.8355	(88)
util rest of house													
	0.9837	0.9683	0.9364	0.8644	0.7355	0.5509	0.3805	0.4313	0.6895	0.9027	0.9712	0.9868	(89)
MIT 2	17.0280	17.4415	18.0596	18.8158	19.4001	19.7382	19.8324	19.8215	19.5982	18.8229	17.7960	16.9714	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.2918	17.6870	18.2783	19.0027	19.5662	19.8956	19.9907	19.9786	19.7565	19.0076	18.0247	17.2371	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1418	17.5370	18.1283	18.8527	19.4162	19.7456	19.8407	19.8286	19.6065	18.8576	17.8747	17.0871	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9730	0.9518	0.9131	0.8371	0.7138	0.5416	0.3786	0.4278	0.6710	0.8764	0.9558	0.9776	(94)
Useful gains	719.8892	870.8712	988.3130	1045.9303	971.7392	729.7852	487.8383	508.0973	718.6563	788.3153	716.9314	674.8202	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2064.7715	2025.9418	1858.9024	1569.6285	1213.8008	799.8030	503.7188	531.7314	859.8632	1298.9663	1703.6947	2048.6789	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

1000.5924	776.2074	647.7186	377.0627	180.0938	0.0000	0.0000	0.0000	0.0000	379.9243	710.4696	1022.1509	(98)

Space heating 5094.2197 (98)
Space heating per m2 (98) / (4) = 41.8760 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5635.1987 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1000.5924	776.2074	647.7186	377.0627	180.0938	0.0000	0.0000	0.0000	0.0000	379.9243	710.4696	1022.1509	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1106.8500	858.6365	716.5028	417.1047	199.2188	0.0000	0.0000	0.0000	0.0000	420.2703	785.9177	1130.6978	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3203	88.0993	87.6602	86.6995	84.8375	79.7000	79.7000	79.7000	79.7000	86.6294	87.8769	88.3969	(217)
Fuel for water heating, kWh/month													
	240.9655	212.7685	224.2129	202.7141	202.6394	192.1655	184.0106	202.6664	202.5435	210.3977	219.9424	234.7970	(219)
Water heating fuel used												2529.8235	(219)
Annual totals kWh/year													
Space heating fuel - main system												5635.1987	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Total delivered energy for all uses												8696.7321	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5635.1987	0.2160	1217.2029	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2529.8235	0.2160	546.4419	(264)
Space and water heating			1763.6448	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Total CO2, kg/year			2039.6022	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER 16.7700 ZC1
Total Floor Area TFA 121.6500
Assumed number of occupants N 2.8695
CO2 emission factor in Table 12 for electricity displaced from grid EF 0.5190
CO2 emissions from appliances, equation (L14) 13.9971 ZC2
CO2 emissions from cooking, equation (L16) 1.5443 ZC3
Total CO2 emissions 32.3115 ZC4
Residual CO2 emissions offset from biofuel CHP 0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year 0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation 0.0000 ZC7
Net CO2 emissions 32.3115 ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3772	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3772	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4810	0.4715	0.4621	0.4149	0.4055	0.3584	0.3584	0.3489	0.3772	0.4055	0.4244	0.4432	(22b)
Effective ac	0.6157	0.6112	0.6068	0.5861	0.5822	0.5642	0.5642	0.5609	0.5711	0.5822	0.5900	0.5982	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			23.8000	1.3258	31.5530			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846			(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.1800	27.2574			(29a)
Plane Ceiling	60.2300		60.2300	0.1300	7.8299			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.9083			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.6285	(36)
Total fabric heat loss					(33) + (36) =		90.5368	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.8783	63.4124	62.9556	60.8102	60.4088	58.5402	58.5402	58.1942	59.2600	60.4088	61.2208	62.0698	(38)
Heat transfer coeff	154.4152	153.9492	153.4924	151.3470	150.9456	149.0770	149.0770	148.7310	149.7968	150.9456	151.7576	152.6066	(39)
Average = Sum(39)m / 12 =												151.3451	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2693	1.2655	1.2618	1.2441	1.2408	1.2255	1.2255	1.2226	1.2314	1.2408	1.2475	1.2545	(40)
HLP (average)												1.2441	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8695	(42)
Average daily hot water use (litres/day)												102.3499	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)
Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)

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Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(64)
								Total per year (kWh/year) = Sum(64)m =				2179.9712	(64)
Heat gains from water heating, kWh/month													
	94.2164	83.5099	88.8046	81.1343	80.6147	73.6210	72.2165	77.1604	76.3712	84.0568	86.9618	92.4648	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	126.6350	124.2707	119.3611	112.6865	108.3531	102.2514	97.0652	103.7102	106.0711	112.9795	120.7803	124.2806	(72)
Total internal gains													
	508.8838	506.6098	489.8968	462.6879	434.5915	407.8653	390.7194	397.2740	411.4384	438.8810	470.4448	494.5697	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.6300	0.7000	0.7700	24.4134	(75)
East	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(76)
Southeast	6.5000	36.7938	0.6300	0.7000	0.7700	73.0904	(77)
Southwest	8.1600	36.7938	0.6300	0.7000	0.7700	91.7565	(79)
West	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(80)

Solar gains	201.6250	354.6775	513.5637	681.1728	802.0501	812.9458	776.8549	684.4494	571.4297	399.7700	243.5844	171.1800	(83)
Total gains	710.5088	861.2873	1003.4605	1143.8607	1236.6416	1220.8112	1167.5743	1081.7235	982.8681	838.6510	714.0292	665.7496	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.7091	54.8747	55.0380	55.8182	55.9666	56.6681	56.6681	56.8000	56.3958	55.9666	55.6672	55.3575	
alpha	4.6473	4.6583	4.6692	4.7212	4.7311	4.7779	4.7779	4.7867	4.7597	4.7311	4.7111	4.6905	
util living area													
	0.9982	0.9952	0.9865	0.9564	0.8734	0.7123	0.5456	0.6046	0.8465	0.9753	0.9960	0.9987	(86)
MIT	19.5874	19.7740	20.0651	20.4403	20.7542	20.9356	20.9856	20.9770	20.8466	20.4290	19.9393	19.5614	(87)
Th 2	19.8649	19.8680	19.8709	19.8849	19.8875	19.8997	19.8997	19.9020	19.8950	19.8875	19.8822	19.8767	(88)
util rest of house													
	0.9976	0.9936	0.9816	0.9395	0.8253	0.6161	0.4174	0.4738	0.7714	0.9627	0.9943	0.9982	(89)
MIT 2	17.9895	18.2638	18.6881	19.2313	19.6480	19.8574	19.8945	19.8927	19.7726	19.2262	18.5158	17.9595	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.2159	18.4778	18.8832	19.4027	19.8047	20.0102	20.0492	20.0464	19.9248	19.3966	18.7176	18.1865	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2159	18.4778	18.8832	19.4027	19.8047	20.0102	20.0492	20.0464	19.9248	19.3966	18.7176	18.1865	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9905	0.9754	0.9300	0.8210	0.6266	0.4355	0.4920	0.7738	0.9549	0.9915	0.9971	(94)
Useful gains	707.7263	853.0903	978.8033	1063.8448	1015.3228	764.9784	508.4214	532.2160	760.5674	800.7933	707.9845	663.8075	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2148.8278	2090.2934	1900.7337	1589.5482	1223.3759	806.5352	514.1909	542.3275	872.5345	1327.8111	1763.0538	2134.4293	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1072.1795	831.4005	685.9162	378.5064	154.7915	0.0000	0.0000	0.0000	0.0000	392.1013	759.6499	1094.1426	(98)
Space heating												5368.6879	(98)
Space heating per m2											(98) / (4) =	44.1322	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5741.9122	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1072.1795	831.4005	685.9162	378.5064	154.7915	0.0000	0.0000	0.0000	0.0000	392.1013	759.6499	1094.1426	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1146.7160	889.1984	733.6002	404.8197	165.5524	0.0000	0.0000	0.0000	0.0000	419.3596	812.4598	1170.2060	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5150	88.3002	87.8504	86.7757	84.4972	79.8000	79.8000	79.8000	79.8000	86.7732	88.0806	88.5868	(217)
Fuel for water heating, kWh/month	243.2784	214.8584	226.5918	205.3422	206.4335	194.9762	186.9332	205.5657	205.3412	212.9489	222.1985	237.1344	(219)
Water heating fuel used												2561.6025	(219)
Annual totals kWh/year													
Space heating fuel - main system												5741.9122	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Total delivered energy for all uses												8835.2245	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5741.9122	0.2160	1240.2530	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2561.6025	0.2160	553.3061	(264)
Space and water heating			1793.5592	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Total CO2, kg/m2/year			2069.5166	(272)
Emissions per m2 for space and water heating			14.7436	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9485	(272b)
Emissions per m2 for pumps and fans			0.3200	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7436 * 1.00) + 1.9485 + 0.3200, rounded to 2 d.p.			17.0100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3777	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4816	0.4722	0.4627	0.4155	0.4061	0.3588	0.3588	0.3494	0.3777	0.4061	0.4249	0.4438	(22b)
Effective ac	0.6160	0.6115	0.6070	0.5863	0.5824	0.5644	0.5644	0.5610	0.5713	0.5824	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9102	63.4430	62.9850	60.8339	60.4314	58.5579	58.5579	58.2109	59.2795	60.4314	61.2456	62.0968	(38)
Heat transfer coeff	160.7852	160.3180	159.8600	157.7089	157.3064	155.4329	155.4329	155.0860	156.1546	157.3064	158.1206	158.9718	(39)
Average = Sum(39)m / 12 =												157.7070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3217	1.3179	1.3141	1.2964	1.2931	1.2777	1.2777	1.2749	1.2836	1.2931	1.2998	1.3068	(40)
HLP (average)												1.2964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.4790	31.0302	32.0204	27.9161	26.7862	23.1145	21.4189	24.5785	24.8721	28.9860	31.6405	34.3596	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	47.6869	46.1759	43.0381	38.7724	36.0030	32.1034	28.7889	33.0357	34.5446	38.9597	43.9452	46.1822	(72)
Total internal gains													
	426.9357	425.5149	410.5739	385.7739	359.2414	334.7173	319.4431	323.5996	336.9118	361.8612	390.6097	413.4713	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	660.6155	836.5798	1005.7850	1175.2410	1288.8031	1276.9070	1219.8041	1116.8642	999.1886	825.1874	672.9196	611.8658	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.5292	31.6211	31.7117	32.1442	32.2265	32.6149	32.6149	32.6879	32.4642	32.2265	32.0605	31.8889	
alpha	3.1019	3.1081	3.1141	3.1429	3.1484	3.1743	3.1743	3.1792	3.1643	3.1484	3.1374	3.1259	
util living area													
	0.9902	0.9794	0.9566	0.9033	0.8047	0.6587	0.5176	0.5732	0.7877	0.9390	0.9829	0.9923	(86)
MIT	18.8075	19.0962	19.5334	20.0800	20.5369	20.8322	20.9426	20.9200	20.6834	20.0635	19.3320	18.7637	(87)
Th 2	19.8239	19.8269	19.8298	19.8436	19.8462	19.8583	19.8583	19.8606	19.8537	19.8462	19.8410	19.8355	(88)
util rest of house													
	0.9880	0.9749	0.9466	0.8803	0.7568	0.5739	0.3999	0.4551	0.7181	0.9197	0.9784	0.9905	(89)
MIT 2	17.8339	18.1222	18.5547	19.0924	19.5133	19.7661	19.8380	19.8295	19.6564	19.0898	18.3687	17.7987	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.9719	18.2602	18.6934	19.2324	19.6584	19.9172	19.9945	19.9840	19.8019	19.2278	18.5052	17.9355	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9719	18.2602	18.6934	19.2324	19.6584	19.9172	19.9945	19.9840	19.8019	19.2278	18.5052	17.9355	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9831	0.9665	0.9340	0.8654	0.7478	0.5787	0.4148	0.4689	0.7144	0.9063	0.9711	0.9864	(94)
Useful gains	649.4401	808.5475	939.4082	1017.1056	963.7799	738.9521	506.0297	523.7242	713.8219	747.8440	653.4501	603.5664	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2198.2383	2141.8855	1949.2406	1629.5101	1251.9047	826.4642	527.6187	555.8333	890.3834	1357.2125	1803.3951	2183.5541	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1152.3058	896.0031	751.3153	440.9313	214.3649	0.0000	0.0000	0.0000	0.0000	453.3702	827.9604	1175.5109	(98)
Space heating												5911.7618	(98)
Space heating per m2											(98) / (4) =	48.5965	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1461.0693	1150.2035	1178.6533	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7955	0.8574	0.8263	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1162.2943	986.2145	973.9338	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1607.9234	1538.5919	1420.4395	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	320.8529	410.9688	332.2002	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1064.0220	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	80.2132	102.7422	83.0501	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												266.0055	(107)
Space cooling per m2												2.1866	(108)
Energy for space heating												48.5965	(99)
Energy for space cooling												2.1866	(108)
Total												50.7831	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3772	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3772	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4810	0.4715	0.4621	0.4149	0.4055	0.3584	0.3584	0.3489	0.3772	0.4055	0.4244	0.4432	(22b)
Effective ac	0.6157	0.6112	0.6068	0.5861	0.5822	0.5642	0.5642	0.5609	0.5711	0.5822	0.5900	0.5982	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			23.8000	1.3258	31.5530			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846			(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.1800	27.2574			(29a)
Plane Ceiling	60.2300		60.2300	0.1300	7.8299			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.9083			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.6285	(36)
Total fabric heat loss (33) + (36) =	90.5368	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.8783	63.4124	62.9556	60.8102	60.4088	58.5402	58.5402	58.1942	59.2600	60.4088	61.2208	62.0698	(38)
Heat transfer coeff	154.4152	153.9492	153.4924	151.3470	150.9456	149.0770	149.0770	148.7310	149.7968	150.9456	151.7576	152.6066	(39)
Average = Sum(39)m / 12 =												151.3451	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2693	1.2655	1.2618	1.2441	1.2408	1.2255	1.2255	1.2226	1.2314	1.2408	1.2475	1.2545	(40)
HLP (average)												1.2441	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)
Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	35.4790	31.0302	32.0204	27.9161	26.7862	23.1145	21.4189	24.5785	24.8721	28.9860	31.6405	34.3596 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788 (71)

Water heating gains (Table 5)

	47.6869	46.1759	43.0381	38.7724	36.0030	32.1034	28.7889	33.0357	34.5446	38.9597	43.9452	46.1822 (72)

Total internal gains

	426.9357	425.5149	410.5739	385.7739	359.2414	334.7173	319.4431	323.5996	336.9118	361.8612	390.6097	413.4713 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.6300	0.7000	0.7700	24.4134	(75)
East	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(76)
Southeast	6.5000	36.7938	0.6300	0.7000	0.7700	73.0904	(77)
Southwest	8.1600	36.7938	0.6300	0.7000	0.7700	91.7565	(79)
West	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(80)

Solar gains	201.6250	354.6775	513.5637	681.1728	802.0501	812.9458	776.8549	684.4494	571.4297	399.7700	243.5844	171.1800	(83)
Total gains	628.5607	780.1925	924.1376	1066.9467	1161.2915	1147.6631	1096.2980	1008.0490	908.3415	761.6312	634.1940	584.6512	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.7091	54.8747	55.0380	55.8182	55.9666	56.6681	56.6681	56.8000	56.3958	55.9666	55.6672	55.3575	
alpha	4.6473	4.6583	4.6692	4.7212	4.7311	4.7779	4.7779	4.7867	4.7597	4.7311	4.7111	4.6905	
util living area	0.9989	0.9969	0.9903	0.9659	0.8937	0.7429	0.5765	0.6405	0.8751	0.9829	0.9976	0.9992	(86)
MIT	19.5260	19.7140	20.0085	20.3922	20.7221	20.9227	20.9818	20.9707	20.8184	20.3763	19.8798	19.5003	(87)
Th 2	19.8649	19.8680	19.8709	19.8849	19.8875	19.8997	19.8997	19.9020	19.8950	19.8875	19.8822	19.8767	(88)
util rest of house	0.9985	0.9957	0.9866	0.9521	0.8502	0.6477	0.4433	0.5059	0.8071	0.9737	0.9965	0.9990	(89)
MIT 2	18.5231	18.7130	19.0079	19.3940	19.6987	19.8641	19.8952	19.8936	19.7923	19.3860	18.8902	18.5067	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.6653	18.8549	19.1497	19.5355	19.8437	20.0141	20.0492	20.0463	19.9378	19.5264	19.0304	18.6475	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6653	18.8549	19.1497	19.5355	19.8437	20.0141	20.0492	20.0463	19.9378	19.5264	19.0304	18.6475	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9943	0.9834	0.9465	0.8481	0.6586	0.4623	0.5248	0.8103	0.9696	0.9953	0.9985	(94)
Useful gains	627.2757	775.7416	908.7876	1009.9003	984.9304	755.8607	506.7645	529.0592	736.0449	738.4746	631.2448	583.8013	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2218.2131	2148.3433	1941.6375	1609.6475	1229.2622	807.1190	514.1898	542.3142	874.4772	1347.3971	1810.5304	2204.7835	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1183.6574	922.3884	768.4403	431.8180	181.7829	0.0000	0.0000	0.0000	0.0000	453.0384	849.0857	1206.0107	(98)
Space heating												5996.2218	(98)
Space heating per m2											(98) / (4) =	49.2908	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1401.3242	1103.1701	1130.3557	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8426	0.9080	0.8778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1180.7458	1001.7100	992.2368	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1456.8591	1394.2342	1293.2529	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000   198.8016   292.0381   223.9560     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          714.7956 (104)
Cooled fraction                                                                                          fC = cooled area / (4) =        1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    49.7004    73.0095    55.9890     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          178.6989 (107)
Space cooling per m2                                                                                                                     1.4690 (108)
Energy for space heating                                                                                                                49.2908 (99)
Energy for space cooling                                                                                                                 1.4690 (108)
Total                                                                                                                                   50.7597 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                  58.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3777	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3966	0.3777	0.3777	0.3494	0.3494	0.3116	0.3211	0.3022	0.3116	0.3305	0.3305	0.3588	(22b)
Effective ac	0.5786	0.5713	0.5713	0.5610	0.5610	0.5486	0.5515	0.5457	0.5486	0.5546	0.5546	0.5644	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.0382	59.2795	59.2795	58.2109	58.2109	56.9157	57.2256	56.6150	56.9157	57.5448	57.5448	58.5579	(38)
Heat transfer coeff	156.9132	156.1546	156.1546	155.0860	155.0860	153.7907	154.1006	153.4900	153.7907	154.4198	154.4198	155.4329	(39)
Average = Sum(39)m / 12 =												154.9032	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2899	1.2836	1.2836	1.2749	1.2749	1.2642	1.2668	1.2617	1.2642	1.2694	1.2694	1.2777	(40)
HLP (average)												1.2734	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
								Total per year (kWh/year) = Sum(64)m =				2150.3437	(64)
RHI water heating demand												2150	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	12.9236	0.4600	0.0000	0.7700	32.4089	(75)
East	1.0300	22.3313	0.4600	0.0000	0.7700	8.1470	(76)
Southeast	6.5000	40.4699	0.4600	0.0000	0.7700	93.1739	(77)
Southwest	1.5000	40.4699	0.4600	0.0000	0.7700	21.5017	(79)
West	1.0300	22.3313	0.4600	0.0000	0.7700	8.1470	(80)
Southwest	6.6600	40.4699	0.4600	0.0000	0.7700	95.4674	(79)

Solar gains	258.8459	410.3562	589.0695	809.3075	931.8962	1012.3008	956.3225	859.1299	711.8749	494.4108	320.4810	217.5768	(83)
Total gains	991.7774	1138.1451	1290.0104	1468.3538	1547.5446	1589.4058	1511.1151	1423.3457	1300.3901	1125.0544	997.9898	931.0277	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3072	32.4642	32.4642	32.6879	32.6879	32.9632	32.8969	33.0278	32.9632	32.8289	32.8289	32.6149	
alpha	3.1538	3.1643	3.1643	3.1792	3.1792	3.1975	3.1931	3.2019	3.1975	3.1886	3.1886	3.1743	
util living area													
	0.9664	0.9483	0.9073	0.8174	0.6711	0.4581	0.3106	0.3375	0.6047	0.8479	0.9428	0.9714	(86)
MIT	19.3278	19.5551	19.9608	20.4304	20.7792	20.9552	20.9909	20.9882	20.8843	20.4555	19.8330	19.2892	(87)
Th 2	19.8488	19.8537	19.8537	19.8606	19.8606	19.8690	19.8670	19.8709	19.8690	19.8649	19.8649	19.8583	(88)
util rest of house													
	0.9593	0.9377	0.8878	0.7796	0.6050	0.3641	0.1996	0.2219	0.5118	0.8069	0.9288	0.9653	(89)
MIT 2	17.6763	18.0038	18.5773	19.2205	19.6562	19.8427	19.8647	19.8677	19.7848	19.2744	18.4142	17.6272	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.9103	18.2237	18.7734	19.3920	19.8154	20.0004	20.0243	20.0265	19.9406	19.4418	18.6153	17.8627	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7603	18.0737	18.6234	19.2420	19.6654	19.8504	19.8743	19.8765	19.7906	19.2918	18.4653	17.7127	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9407	0.9150	0.8612	0.7556	0.5925	0.3625	0.2004	0.2225	0.5048	0.7815	0.9052	0.9483	(94)
Useful gains	932.9584	1041.4097	1110.9037	1109.4872	916.9201	576.0920	302.7795	316.6587	656.4013	879.2034	903.3395	882.8882	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1986.5696	1947.8197	1752.5866	1448.8145	1033.7024	592.1555	304.2363	318.7156	705.9886	1187.7587	1616.0464	1960.4325	(97)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	783.8867	609.1075	477.4121	244.3156	86.8861	0.0000	0.0000	0.0000	0.0000	229.5651	513.1490	801.6930 (98)
Space heating												3746.0151 (98)
RHI space heating demand												3746 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3777	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4816	0.4722	0.4627	0.4155	0.4061	0.3588	0.3588	0.3494	0.3777	0.4061	0.4249	0.4438	(22b)
Effective ac	0.6160	0.6115	0.6070	0.5863	0.5824	0.5644	0.5644	0.5610	0.5713	0.5824	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18249.9590 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.0202 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0513 (36)
Total fabric heat loss	(33) + (36) =	96.8750 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9102	63.4430	62.9850	60.8339	60.4314	58.5579	58.5579	58.2109	59.2795	60.4314	61.2456	62.0968	(38)
Heat transfer coeff	160.7852	160.3180	159.8600	157.7089	157.3064	155.4329	155.4329	155.0860	156.1546	157.3064	158.1206	158.9718	(39)
Average = Sum(39)m / 12 =												157.7070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3217	1.3179	1.3141	1.2964	1.2931	1.2777	1.2777	1.2749	1.2836	1.2931	1.2998	1.3068	(40)
HLP (average)												1.2964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8695 (42)
Average daily hot water use (litres/day)		102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945	(83)
Total gains	966.6113	1138.8538	1296.1521	1448.5134	1545.2101	1519.2947	1455.1535	1357.4805	1250.7920	1093.9698	959.8188	911.8454	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.5292	31.6211	31.7117	32.1442	32.2265	32.6149	32.6149	32.6879	32.4642	32.2265	32.0605	31.8889	
alpha	3.1019	3.1081	3.1141	3.1429	3.1484	3.1743	3.1743	3.1792	3.1643	3.1484	3.1374	3.1259	
util living area													
	0.9727	0.9545	0.9206	0.8512	0.7378	0.5837	0.4463	0.4909	0.7005	0.8850	0.9567	0.9768	(86)
MIT	19.1163	19.3854	19.7834	20.2663	20.6489	20.8821	20.9624	20.9487	20.7806	20.2738	19.6109	19.0711	(87)
Th 2	19.8239	19.8269	19.8298	19.8436	19.8462	19.8583	19.8583	19.8606	19.8537	19.8462	19.8410	19.8355	(88)
util rest of house													
	0.9670	0.9453	0.9043	0.8205	0.6839	0.5004	0.3400	0.3826	0.6233	0.8542	0.9464	0.9720	(89)
MIT 2	17.3552	17.7432	18.3109	18.9883	19.4883	19.7671	19.8396	19.8328	19.6640	19.0179	18.0820	17.2971	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.6048	17.9759	18.5196	19.1694	19.6528	19.9251	19.9987	19.9910	19.8222	19.1959	18.2986	17.5485	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4548	17.8259	18.3696	19.0194	19.5028	19.7751	19.8487	19.8410	19.6722	19.0459	18.1486	17.3985	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9501	0.9234	0.8778	0.7940	0.6657	0.4938	0.3390	0.3806	0.6095	0.8269	0.9249	0.9568	(94)
Useful gains	918.4172	1051.5790	1137.7832	1150.1622	1028.6910	750.3001	493.3597	516.6589	762.3568	904.6185	887.7104	872.4798	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2115.0960	2072.2587	1897.4724	1595.9214	1227.4275	804.3831	504.9563	533.6462	870.1308	1328.5908	1747.0175	2098.1920	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating kWh

890.3290	685.8967	565.2088	320.9466	147.8600	0.0000	0.0000	0.0000	0.0000	315.4354	618.7011	911.9299	(98)

Space heating 4456.3075 (98)
Space heating per m2 (98) / (4) = 36.6322 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4929.5437 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	890.3290	685.8967	565.2088	320.9466	147.8600	0.0000	0.0000	0.0000	0.0000	315.4354	618.7011	911.9299	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	984.8773	758.7353	625.2309	355.0295	163.5619	0.0000	0.0000	0.0000	0.0000	348.9329	684.4038	1008.7720	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1177	87.8681	87.3734	86.3004	84.3145	79.7000	79.7000	79.7000	79.7000	86.1637	87.6006	88.2045	(217)
Fuel for water heating, kWh/month													
	241.5196	213.3285	224.9489	203.6516	203.8963	192.1655	184.0106	202.6664	202.5435	211.5348	220.6362	235.3093	(219)
Water heating fuel used												2536.2111	(219)
Annual totals kWh/year													
Space heating fuel - main system												4929.5437	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Total delivered energy for all uses												7997.4646	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4929.5437	3.4800	171.5481	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2536.2111	3.4800	88.2601	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	456.7098	13.1900	60.2400	(250)
Additional standing charges			120.0000	(251)
Total energy cost			449.9408	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.1340 (257)
SAP value 84.1812
SAP rating (Section 12) 84 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4929.5437	0.2160	1064.7814	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2536.2111	0.2160	547.8216	(264)
Space and water heating			1612.6030	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Total kg/year			1888.5604	(272)
CO2 emissions per m2			15.5200	(273)
EI value			84.8145	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8456 = 4.115, stars = 4
Water heating environmental impact	0.216 / 0.8456 = 0.2554, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3777	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3966	0.3777	0.3777	0.3494	0.3494	0.3116	0.3211	0.3022	0.3116	0.3305	0.3305	0.3588	(22b)
Effective ac	0.5786	0.5713	0.5713	0.5610	0.5610	0.5486	0.5515	0.5457	0.5486	0.5546	0.5546	0.5644	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.0382	59.2795	59.2795	58.2109	58.2109	56.9157	57.2256	56.6150	56.9157	57.5448	57.5448	58.5579	(38)
Heat transfer coeff	156.9132	156.1546	156.1546	155.0860	155.0860	153.7907	154.1006	153.4900	153.7907	154.4198	154.4198	155.4329	(39)
Average = Sum(39)m / 12 =												154.9032	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2899	1.2836	1.2836	1.2749	1.2749	1.2642	1.2668	1.2617	1.2642	1.2694	1.2694	1.2777	(40)
HLP (average)												1.2734	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	12.9236	0.4600	0.0000	0.7700	32.4089	(75)
East	1.0300	22.3313	0.4600	0.0000	0.7700	8.1470	(76)
Southeast	6.5000	40.4699	0.4600	0.0000	0.7700	93.1739	(77)
Southwest	1.5000	40.4699	0.4600	0.0000	0.7700	21.5017	(79)
West	1.0300	22.3313	0.4600	0.0000	0.7700	8.1470	(80)
Southwest	6.6600	40.4699	0.4600	0.0000	0.7700	95.4674	(79)

Solar gains	258.8459	410.3562	589.0695	809.3075	931.8962	1012.3008	956.3225	859.1299	711.8749	494.4108	320.4810	217.5768	(83)
Total gains	991.7774	1138.1451	1290.0104	1468.3538	1547.5446	1589.4058	1511.1151	1423.3457	1300.3901	1125.0544	997.9898	931.0277	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3072	32.4642	32.4642	32.6879	32.6879	32.9632	32.8969	33.0278	32.9632	32.8289	32.8289	32.6149	
alpha	3.1538	3.1643	3.1643	3.1792	3.1792	3.1975	3.1931	3.2019	3.1975	3.1886	3.1886	3.1743	
util living area													
	0.9664	0.9483	0.9073	0.8174	0.6711	0.4581	0.3106	0.3375	0.6047	0.8479	0.9428	0.9714	(86)
MIT	19.3278	19.5551	19.9608	20.4304	20.7792	20.9552	20.9909	20.9882	20.8843	20.4555	19.8330	19.2892	(87)
Th 2	19.8488	19.8537	19.8537	19.8606	19.8606	19.8690	19.8670	19.8709	19.8690	19.8649	19.8649	19.8583	(88)
util rest of house													
	0.9593	0.9377	0.8878	0.7796	0.6050	0.3641	0.1996	0.2219	0.5118	0.8069	0.9288	0.9653	(89)
MIT 2	17.6763	18.0038	18.5773	19.2205	19.6562	19.8427	19.8647	19.8677	19.7848	19.2744	18.4142	17.6272	(90)
Living area fraction										fLA = Living area / (4) =		0.1417	(91)
MIT	17.9103	18.2237	18.7734	19.3920	19.8154	20.0004	20.0243	20.0265	19.9406	19.4418	18.6153	17.8627	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7603	18.0737	18.6234	19.2420	19.6654	19.8504	19.8743	19.8765	19.7906	19.2918	18.4653	17.7127	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9407	0.9150	0.8612	0.7556	0.5925	0.3625	0.2004	0.2225	0.5048	0.7815	0.9052	0.9483	(94)
Useful gains	932.9584	1041.4097	1110.9037	1109.4872	916.9201	576.0920	302.7795	316.6587	656.4013	879.2034	903.3395	882.8882	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1986.5696	1947.8197	1752.5866	1448.8145	1033.7024	592.1555	304.2363	318.7156	705.9886	1187.7587	1616.0464	1960.4325	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating kWh

783.8867	609.1075	477.4121	244.3156	86.8861	0.0000	0.0000	0.0000	0.0000	229.5651	513.1490	801.6930 (98)

Space heating 3746.0151 (98)
Space heating per m2 (98) / (4) = 30.7934 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4143.8220 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	783.8867	609.1075	477.4121	244.3156	86.8861	0.0000	0.0000	0.0000	0.0000	229.5651	513.1490	801.6930	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	867.1313	673.7915	528.1107	270.2606	96.1129	0.0000	0.0000	0.0000	0.0000	253.9437	567.6427	886.8286	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.8808	87.6315	86.9940	85.5923	82.9981	79.7000	79.7000	79.7000	79.7000	85.3299	87.1971	87.9712	(217)
Fuel for water heating, kWh/month													
	242.1708	213.9045	225.9300	205.3364	207.1301	192.1655	184.0106	202.6664	202.5435	213.6018	221.6571	235.9335	(219)
Water heating fuel used												2547.0500	(219)
Annual totals kWh/year													
Space heating fuel - main system												4143.8220	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Total delivered energy for all uses												7222.5819	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4143.8220	3.9200	162.4378	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2547.0500	3.9200	99.8444	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	456.7098	16.9600	77.4580	(250)
Additional standing charges			88.0000	(251)
Total energy cost			440.4602	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4143.8220	0.2160	895.0656	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.0500	0.2160	550.1628	(264)
Space and water heating			1445.2284	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Total kg/year			1721.1858	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4143.8220	1.2200	5055.4629	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2547.0500	1.2200	3107.4010	(264)
Space and water heating			8162.8639	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	456.7098	3.0700	1402.0992	(268)
Primary energy kWh/year			9795.2131	(272)
Primary energy kWh/m2/year			80.5196	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 44	-261 kg (15.2%)
U Solar photovoltaic panels	+ 8.0	-£ 309	-947 kg (64.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	2.15 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	7.78 kg/m²	A 94	A 94
Total Savings	£353	9.93 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£90	£99	-£8
Mains gas	£350	£298	£52
Space heating	£263	£264	-£1
Water heating	£100	£55	£45
Lighting	£77	£77	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£440	£88	£353
Total cost of uses	£440	£87	£353
Delivered energy	59 kWh/m²	34 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.7 tonnes	0.5 tonnes	1.2 tonnes
CO2 emissions per m²	14 kg/m²	4 kg/m²	10 kg/m²
Primary energy	81 kWh/m²	22 kWh/m²	58 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3777	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4816	0.4722	0.4627	0.4155	0.4061	0.3588	0.3588	0.3494	0.3777	0.4061	0.4249	0.4438	(22b)
Effective ac	0.6160	0.6115	0.6070	0.5863	0.5824	0.5644	0.5644	0.5610	0.5713	0.5824	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.9102	63.4430	62.9850	60.8339	60.4314	58.5579	58.5579	58.2109	59.2795	60.4314	61.2456	62.0968	(38)
Heat transfer coeff	160.7852	160.3180	159.8600	157.7089	157.3064	155.4329	155.4329	155.0860	156.1546	157.3064	158.1206	158.9718	(39)
Average = Sum(39)m / 12 =												157.7070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3217	1.3179	1.3141	1.2964	1.2931	1.2777	1.2777	1.2749	1.2836	1.2931	1.2998	1.3068	(40)
HLP (average)												1.2964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920 (45)
Energy content (annual)										Total = Sum(45)m =		1610.3627 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538 (46)
Water storage loss:												
Store volume												190.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7851 (55)
Total storage loss												
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384 (56)
If cylinder contains dedicated solar storage												
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	204.9537	180.3412	187.2819	161.3844	151.2519	132.9351	125.7616	141.5609	148.4102	173.0026	185.6645	199.6856 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1262 (H8)
Utilisation factor												0.5885 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												109.5000 (H13)
Daily hot water demand												102.3499 (H14)
Volume ratio Veff/V												1.0699 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-938.4673 (H17)
Solar input	-27.2137	-45.4118	-77.3415	-103.6529	-128.0544	-125.8979	-124.2341	-108.5439	-85.0117	-58.0530	-32.2793	-22.7732 (63)
								Solar input (sum of months) = Sum(63)m =				-938.4673 (63)
Output from w/h												
	177.7400	134.9294	109.9404	57.7316	23.1976	7.0373	1.5275	33.0169	63.3986	114.9497	153.3851	176.9123 (64)
									Total per year (kWh/year) = Sum(64)m =			1053.7664 (64)
Heat gains from water heating, kWh/month												
	85.9091	76.0065	79.3807	67.6920	62.0719	55.4963	53.4876	59.1759	64.0096	74.6329	78.9225	84.1574 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	115.4692	113.1049	106.6945	94.0167	83.4300	77.0782	71.8920	79.5375	88.9022	100.3130	109.6145	113.1148	(72)
Total internal gains													
	724.4714	719.3289	690.9801	643.0823	593.4310	554.6375	532.3250	542.7488	574.0519	620.6827	669.0488	704.9908	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
East	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(76)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	233.6798	411.0649	595.2111	789.4671	929.5617	942.1897	900.3610	793.2647	662.2768	463.3262	282.3099	198.3945 (83)
Total gains	958.1513	1130.3938	1286.1912	1432.5494	1522.9927	1496.8272	1432.6860	1336.0135	1236.3287	1084.0089	951.3587	903.3854 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.5292	31.6211	31.7117	32.1442	32.2265	32.6149	32.6149	32.6879	32.4642	32.2265	32.0605	31.8889	
alpha	3.1019	3.1081	3.1141	3.1429	3.1484	3.1743	3.1743	3.1792	3.1643	3.1484	3.1374	3.1259	
util living area													
	0.9733	0.9553	0.9220	0.8544	0.7435	0.5901	0.4524	0.4975	0.7053	0.8872	0.9577	0.9774	(86)
MIT	19.1080	19.3777	19.7754	20.2564	20.6404	20.8783	20.9609	20.9467	20.7760	20.2668	19.6030	19.0627	(87)
Th 2	19.8239	19.8269	19.8298	19.8436	19.8462	19.8583	19.8583	19.8606	19.8537	19.8462	19.8410	19.8355	(88)
util rest of house													
	0.9678	0.9463	0.9059	0.8240	0.6899	0.5066	0.3450	0.3882	0.6284	0.8567	0.9475	0.9727	(89)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.3434	17.7323	18.2999	18.9756	19.4788	19.7639	19.8388	19.8317	19.6595	19.0088	18.0710	17.2850	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.5935	17.9655	18.5090	19.1571	19.6434	19.9218	19.9978	19.9897	19.8177	19.1871	18.2881	17.5370	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4435	17.8155	18.3590	19.0071	19.4934	19.7718	19.8478	19.8397	19.6677	19.0371	18.1381	17.3870	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9511	0.9245	0.8795	0.7975	0.6713	0.4997	0.3439	0.3860	0.6142	0.8295	0.9262	0.9577	(94)
Useful gains	911.2928	1045.0675	1131.2176	1142.4175	1022.4589	747.9710	492.7372	515.7605	759.3240	899.1577	881.1731	865.1989	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2113.2764	2070.5816	1895.7784	1593.9820	1225.9525	803.8672	504.8171	533.4460	869.4279	1327.2075	1745.3495	2096.3539	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	894.2758	689.1454	568.8332	325.1264	151.3993	0.0000	0.0000	0.0000	0.0000	318.4691	622.2070	915.9793	(98)
Space heating												4485.4355	(98)
Space heating per m2											(98) / (4) =	36.8716	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4961.7649	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	894.2758	689.1454	568.8332	325.1264	151.3993	0.0000	0.0000	0.0000	0.0000	318.4691	622.2070	915.9793	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	989.2431	762.3290	629.2403	359.6531	167.4771	0.0000	0.0000	0.0000	0.0000	352.2888	688.2821	1013.2515	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	177.7400	134.9294	109.9404	57.7316	23.1976	7.0373	1.5275	33.0169	63.3986	114.9497	153.3851	176.9123	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4316	88.4556	88.4761	88.6062	88.8158	79.7000	79.7000	79.7000	79.7000	87.2919	88.0619	88.4772	(217)
Fuel for water heating, kWh/month	200.9916	152.5391	124.2600	65.1552	26.1187	8.8297	1.9166	41.4265	79.5465	131.6843	174.1788	199.9525	(219)
Water heating fuel used												1206.5996	(219)
Annual totals kWh/year													
Space heating fuel - main system												4961.7649	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												5022.8349	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4961.7649	3.4800	172.6694	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1206.5996	3.4800	41.9897	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	456.7098	13.1900	60.2400	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			183.5637	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4626	(257)
SAP value		93.5464	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4961.7649	0.2160	1071.7412	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1206.5996	0.2160	260.6255	(264)
Space and water heating			1332.3667	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			737.8369	(272)
CO2 emissions per m2			6.0700	(273)
EI value			94.0672	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3777	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3777	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3966	0.3777	0.3777	0.3494	0.3494	0.3116	0.3211	0.3022	0.3116	0.3305	0.3305	0.3588	(22b)
Effective ac	0.5786	0.5713	0.5713	0.5610	0.5610	0.5486	0.5515	0.5457	0.5486	0.5546	0.5546	0.5644	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.0382	59.2795	59.2795	58.2109	58.2109	56.9157	57.2256	56.6150	56.9157	57.5448	57.5448	58.5579	(38)
Heat transfer coeff	156.9132	156.1546	156.1546	155.0860	155.0860	153.7907	154.1006	153.4900	153.7907	154.4198	154.4198	155.4329	(39)
Average = Sum(39)m / 12 =												154.9032	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2899	1.2836	1.2836	1.2749	1.2749	1.2642	1.2668	1.2617	1.2642	1.2694	1.2694	1.2777	(40)
HLP (average)												1.2734	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920 (45)
Energy content (annual)										Total = Sum(45)m =		1610.3627 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538 (46)
Water storage loss:												
Store volume												190.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7851 (55)
Total storage loss												
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384 (56)
If cylinder contains dedicated solar storage												
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	204.9537	180.3412	187.2819	161.3844	151.2519	132.9351	125.7616	141.5609	148.4102	173.0026	185.6645	199.6856 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1140.0998 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1915.3676 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1894 (H8)
Utilisation factor												0.5686 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												109.5000 (H13)
Daily hot water demand												102.3499 (H14)
Volume ratio Veff/V												1.0699 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-957.6479 (H17)
Solar input	-29.4759	-44.3023	-74.6106	-103.1347	-124.2089	-130.7244	-127.5855	-113.9346	-88.9264	-60.4949	-35.8288	-24.4210 (63)
									Solar input (sum of months) = Sum(63)m =			-957.6479 (63)
Output from w/h												
	175.4778	136.0389	112.6713	58.2497	27.0431	2.2107	0.0000	27.6263	59.4839	112.5077	149.8357	175.2646 (64)
										Total per year (kWh/year) = Sum(64)m =		1036.4097 (64)
Heat gains from water heating, kWh/month												
	85.9091	76.0065	79.3807	67.6920	62.0719	55.4963	53.4876	59.1759	64.0096	74.6329	78.9225	84.1574 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	115.4692	113.1049	106.6945	94.0167	83.4300	77.0782	71.8920	79.5375	88.9022	100.3130	109.6145	113.1148	(72)
Total internal gains													
	724.4714	719.3289	690.9801	643.0823	593.4310	554.6375	532.3250	542.7488	574.0519	620.6827	669.0488	704.9908	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	12.9236	0.4600	0.0000	0.7700	32.4089	(75)
East	1.0300	22.3313	0.4600	0.0000	0.7700	8.1470	(76)
Southeast	6.5000	40.4699	0.4600	0.0000	0.7700	93.1739	(77)
Southwest	1.5000	40.4699	0.4600	0.0000	0.7700	21.5017	(79)
West	1.0300	22.3313	0.4600	0.0000	0.7700	8.1470	(80)
Southwest	6.6600	40.4699	0.4600	0.0000	0.7700	95.4674	(79)

Solar gains	258.8459	410.3562	589.0695	809.3075	931.8962	1012.3008	956.3225	859.1299	711.8749	494.4108	320.4810	217.5768 (83)
Total gains	983.3173	1129.6851	1280.0496	1452.3897	1525.3272	1566.9383	1488.6476	1401.8787	1285.9268	1115.0935	989.5298	922.5677 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.3072	32.4642	32.4642	32.6879	32.6879	32.9632	32.8969	33.0278	32.9632	32.8289	32.8289	32.6149	
alpha	3.1538	3.1643	3.1643	3.1792	3.1792	3.1975	3.1931	3.2019	3.1975	3.1886	3.1886	3.1743	
util living area													
	0.9672	0.9493	0.9089	0.8209	0.6772	0.4637	0.3151	0.3423	0.6096	0.8505	0.9440	0.9721	(86)
MIT	19.3197	19.5475	19.9532	20.4219	20.7731	20.9536	20.9905	20.9877	20.8815	20.4494	19.8256	19.2809	(87)
Th 2	19.8488	19.8537	19.8537	19.8606	19.8606	19.8690	19.8670	19.8709	19.8690	19.8649	19.8649	19.8583	(88)
util rest of house													
	0.9602	0.9388	0.8897	0.7836	0.6113	0.3689	0.2026	0.2252	0.5165	0.8099	0.9302	0.9661	(89)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.6647	17.9931	18.5670	19.2099	19.6500	19.8417	19.8646	19.8675	19.7825	19.2669	18.4039	17.6153 (90)
Living area fraction										fLA = Living area / (4) =		0.1417 (91)
MIT	17.8992	18.2134	18.7634	19.3816	19.8091	19.9993	20.0241	20.0263	19.9383	19.4345	18.6053	17.8514 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.7492	18.0634	18.6134	19.2316	19.6591	19.8493	19.8741	19.8763	19.7883	19.2845	18.4553	17.7014 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9418	0.9163	0.8630	0.7594	0.5984	0.3672	0.2033	0.2258	0.5092	0.7844	0.9067	0.9493	(94)
Useful gains	926.0693	1035.0986	1104.7382	1102.8831	912.6893	575.3191	302.6921	316.5358	654.8096	874.6401	897.2440	875.8247	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1984.8313	1946.2209	1751.0253	1447.2058	1032.7405	591.9868	304.2142	318.6852	705.6345	1186.6348	1614.5113	1958.6680	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	787.7189	612.2742	480.8376	247.9123	89.3181	0.0000	0.0000	0.0000	0.0000	232.1240	516.4325	805.6354	(98)
Space heating												3772.2531	(98)
Space heating per m2											(98) / (4) =	31.0091	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4172.8463	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	787.7189	612.2742	480.8376	247.9123	89.3181	0.0000	0.0000	0.0000	0.0000	232.1240	516.4325	805.6354	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	871.3705	677.2945	531.9000	274.2393	98.8032	0.0000	0.0000	0.0000	0.0000	256.7744	571.2748	891.1896	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	175.4778	136.0389	112.6713	58.2497	27.0431	2.2107	0.0000	27.6263	59.4839	112.5077	149.8357	175.2646	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.2417	88.2462	88.1533	88.1484	87.6647	79.7000	79.7000	79.7000	79.7000	86.6043	87.7506	88.2823	(217)
Fuel for water heating, kWh/month	198.8603	154.1584	127.8130	66.0814	30.8483	2.7738	0.0000	34.6628	74.6347	129.9101	170.7517	198.5275	(219)
Water heating fuel used												1189.0219	(219)
Annual totals kWh/year													
Space heating fuel - main system												4172.8463	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												4119.4184	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4172.8463	3.9200	163.5756	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1189.0219	3.9200	46.6097	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	456.7098	16.9600	77.4580	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			87.4657	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4172.8463	0.2160	901.3348	(261)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1189.0219	0.2160	256.8287 (264)
Space and water heating			1158.1635 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	456.7098	0.5190	237.0324 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			513.3321 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4172.8463	1.2200	5090.8725 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1189.0219	1.2200	1450.6068 (264)
Space and water heating			6541.4792 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	456.7098	3.0700	1402.0992 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			2727.1583 (272)
Primary energy kWh/m2/year			22.4181 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	150.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	415.02 (P1)
Transmission heat loss coefficient	96.88 (37)
Summer heat loss coefficient	511.90 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.0800	98.8453	0.4600	0.0000	0.9000	289.7273
East	1.0300	117.5071	0.4600	0.0000	0.9000	50.1074
South East	6.5000	119.9223	0.4600	0.0000	0.9000	322.7110
South West	1.5000	119.9223	0.4600	0.0000	0.9000	74.4718
West	1.0300	117.5071	0.4600	0.0000	0.9000	50.1074
South West	6.6600	119.9223	0.4600	0.0000	0.9000	330.6547
total:						1117.7796

	Jun	Jul	Aug	
Solar gains	1183	1118	1004	(P4)
Internal gains	574	552	561	
Total summer gains	1757	1670	1565	(P5)
Summer gain/loss ratio	3.43	3.26	3.06	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.0)	0.95	0.95	0.95	
Threshold temperature	20.38	22.11	21.81	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-326	**Issued on Date**	19/10/2022
Assessment Reference	Plot 326	**Prop Type Ref**	Alston-Opp-DET
Property	Plot 326, 4 Bed, K, WC, B, 2xEn		

SAP Rating	85 B	**DER**	15.80	**TER**	16.26
Environmental	85 B	**% DER<TER**	2.81		
CO_2 Emissions (t/year)	2.01	**DFEE**	50.73	**TFEE**	59.49
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.73		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Detached House, total floor area 151 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.26 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.80 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H18

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.54 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 15.40 m², No overhang
Windows facing South East: 2.07 m², No overhang
Windows facing South West: 14.64 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.032 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3788	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3788	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4830	0.4735	0.4640	0.4167	0.4072	0.3599	0.3599	0.3504	0.3788	0.4072	0.4262	0.4451	(22b)
Effective ac	0.6166	0.6121	0.6077	0.5868	0.5829	0.5647	0.5647	0.5614	0.5717	0.5829	0.5908	0.5991	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.3015	78.7190	78.1481	75.4666	74.9649	72.6294	72.6294	72.1969	73.5290	74.9649	75.9799	77.0409	(38)
Heat transfer coeff	197.2038	196.6214	196.0505	193.3689	192.8672	190.5317	190.5317	190.0992	191.4313	192.8672	193.8822	194.9432	(39)
Average = Sum(39)m / 12 =												193.3665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3077	1.3039	1.3001	1.2823	1.2790	1.2635	1.2635	1.2606	1.2694	1.2790	1.2857	1.2927	(40)
HLP (average)												1.2823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use

	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081 (44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668 (45)
Energy content (annual)										Total = Sum(45)m =		1635.0105 (45)

Distribution loss (46)m = 0.15 x (45)m

	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250 (46)

Water storage loss:

Store volume	210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5400 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.8316 (55)

Total storage loss

	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796 (56)

If cylinder contains dedicated solar storage

	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Total heat required for water heating calculated for each month

	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088 (64)
								Total per year (kWh/year) = Sum(64)m =				2212.4405 (64)

Heat gains from water heating, kWh/month

	95.5975	84.7331	90.1029	82.3171	81.7876	74.6889	73.2609	78.2804	77.4812	85.2824	88.2339	93.8191 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)

Water heating gains (Table 5)

	128.4913	126.0909	121.1061	114.3293	109.9296	103.7346	98.4690	105.2156	107.6127	114.6269	122.5470	126.1009	(72)

Total internal gains

	548.6193	546.3444	528.1942	498.4888	467.5409	438.2917	419.6432	426.2643	441.8268	471.7696	506.2379	532.8460	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.4600	0.0000	0.7700	61.5448	(75)
Southeast	2.0700	36.7938	0.4600	0.0000	0.7700	26.9770	(77)
Southwest	5.1500	36.7938	0.4600	0.0000	0.7700	67.1167	(79)
Southwest	9.4900	36.7938	0.4600	0.0000	0.7700	123.6772	(79)

Solar gains	279.3158	496.2209	733.2506	999.5472	1202.6498	1230.4941	1171.1208	1014.0107	824.5900	563.0703	338.2788	236.6272	(83)
Total gains	827.9351	1042.5653	1261.4448	1498.0361	1670.1907	1668.7858	1590.7641	1440.2750	1266.4168	1034.8399	844.5167	769.4732	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8981	29.9866	30.0739	30.4910	30.5703	30.9450	30.9450	31.0154	30.7996	30.5703	30.4103	30.2448	
alpha	2.9932	2.9991	3.0049	3.0327	3.0380	3.0630	3.0630	3.0677	3.0533	3.0380	3.0274	3.0163	
util living area	0.9879	0.9757	0.9496	0.8885	0.7785	0.6262	0.4892	0.5477	0.7689	0.9304	0.9793	0.9903	(86)
MIT	18.7438	19.0398	19.4977	20.0742	20.5468	20.8392	20.9445	20.9210	20.6804	20.0420	19.2874	18.7002	(87)
Th 2	19.8348	19.8378	19.8408	19.8547	19.8574	19.8696	19.8696	19.8718	19.8649	19.8574	19.8521	19.8465	(88)
util rest of house	0.9854	0.9707	0.9388	0.8640	0.7294	0.5437	0.3778	0.4346	0.6993	0.9099	0.9742	0.9882	(89)
MIT 2	16.8342	17.2652	17.9263	18.7471	19.3798	19.7390	19.8399	19.8258	19.5708	18.7221	17.6367	16.7774	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	17.0501	17.4658	18.1039	18.8972	19.5117	19.8634	19.9648	19.9496	19.6963	18.8713	17.8234	16.9948	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9001	17.3158	17.9539	18.7472	19.3617	19.7134	19.8148	19.7996	19.5463	18.7213	17.6734	16.8448	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9538	0.9140	0.8338	0.7046	0.5312	0.3721	0.4267	0.6759	0.8814	0.9587	0.9793	(94)
Useful gains	807.1005	994.4002	1152.9501	1249.0408	1176.7489	886.4059	591.8449	614.5577	856.0125	912.1493	809.6482	753.5286	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2484.7822	2441.2126	2245.5500	1904.1383	1477.6959	974.2688	612.5215	646.2625	1042.5864	1566.3345	2049.9879	2465.0260	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

1248.1952	972.2580	812.8943	471.6702	223.9046	0.0000	0.0000	0.0000	0.0000	486.7138	893.0446	1273.3540	(98)

Space heating 6382.0348 (98)
Space heating per m2 (98) / (4) = 42.3212 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.6000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 7044.1885 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1248.1952	972.2580	812.8943	471.6702	223.9046	0.0000	0.0000	0.0000	0.0000	486.7138	893.0446	1273.3540	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1377.6989	1073.1324	897.2344	520.6073	247.1353	0.0000	0.0000	0.0000	0.0000	537.2117	985.7005	1405.4680	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.8275	88.6377	88.2475	87.3577	85.5420	79.9000	79.9000	79.9000	79.9000	87.3465	88.4449	88.8926	(217)
Fuel for water heating, kWh/month													
	246.0473	217.2386	228.9384	207.0117	206.9441	197.6205	189.4615	208.3555	208.1309	214.7018	224.5868	239.8498	(219)
Water heating fuel used												2588.8871	(219)
Annual totals kWh/year													
Space heating fuel - main system												7044.1885	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Total delivered energy for all uses												10215.0162	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7044.1885	0.2160	1521.5447	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2588.8871	0.2160	559.1996	(264)
Space and water heating			2080.7443	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Total CO2, kg/year			2382.7715	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.8000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER 15.8000 ZC1
Total Floor Area TFA 150.8000
Assumed number of occupants N 2.9354
CO2 emission factor in Table 12 for electricity displaced from grid EF 0.5190
CO2 emissions from appliances, equation (L14) 12.6293 ZC2
CO2 emissions from cooking, equation (L16) 1.2563 ZC3
Total CO2 emissions 29.6856 ZC4
Residual CO2 emissions offset from biofuel CHP 0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year 0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation 0.0000 ZC7
Net CO2 emissions 29.6856 ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1026	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3526	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3526	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4496	0.4408	0.4320	0.3879	0.3791	0.3350	0.3350	0.3262	0.3526	0.3791	0.3967	0.4144	(22b)
Effective ac	0.6011	0.5972	0.5933	0.5752	0.5719	0.5561	0.5561	0.5532	0.5622	0.5719	0.5787	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			32.1100	1.3258	42.5701			(27)
GF B&B J150 P/A=0.50			76.5900	0.1300	9.9567			(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.1800	24.6510			(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.1800	4.1526			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	2.3500		2.3500	0.1300	0.3055			(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9692			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.1491	(36)
Total fabric heat loss					(33) + (36) =		112.1183	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3013	76.7965	76.3018	73.9778	73.5430	71.5190	71.5190	71.1441	72.2986	73.5430	74.4226	75.3422	(38)
Heat transfer coeff	189.4196	188.9148	188.4201	186.0961	185.6613	183.6373	183.6373	183.2624	184.4169	185.6613	186.5409	187.4605	(39)
Average = Sum(39)m / 12 =												186.0940	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2561	1.2528	1.2495	1.2341	1.2312	1.2178	1.2178	1.2153	1.2229	1.2312	1.2370	1.2431	(40)
HLP (average)												1.2340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9354 (42)
Average daily hot water use (litres/day)		103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250	(46)
Water storage loss:													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	221.2622	194.9983	204.7371	183.4581	179.7286	160.5161	154.0843	169.1807	168.9140	190.2392	201.2529	215.9134	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	221.2622	194.9983	204.7371	183.4581	179.7286	160.5161	154.0843	169.1807	168.9140	190.2392	201.2529	215.9134	(64)
Total per year (kWh/year) = Sum(64)m =												2244.2849	(64)
Heat gains from water heating, kWh/month													
	97.7612	86.6873	92.2666	84.4110	83.9513	76.7828	75.4246	80.4441	79.5750	87.4461	90.3277	95.9827	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	131.3995	128.9990	124.0142	117.2375	112.8378	106.6427	101.3771	108.1238	110.5209	117.5350	125.4552	129.0091	(72)
Total internal gains													
	551.5274	549.2525	531.1024	501.3970	470.4491	441.1998	422.5514	429.1725	444.7350	474.6777	509.1461	535.7542	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.6300	0.7000	0.7700	53.1025	(75)
Southeast	2.0700	36.7938	0.6300	0.7000	0.7700	23.2765	(77)
Southwest	14.6400	36.7938	0.6300	0.7000	0.7700	164.6220	(79)

Solar gains	241.0010	428.1523	632.6677	862.4354	1037.6776	1061.7024	1010.4736	874.9149	711.4778	485.8318	291.8758	204.1681	(83)
Total gains	792.5284	977.4049	1163.7701	1363.8324	1508.1267	1502.9023	1433.0250	1304.0874	1156.2127	960.5095	801.0219	739.9223	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2858	55.4336	55.5791	56.2732	56.4050	57.0267	57.0267	57.1433	56.7856	56.4050	56.1390	55.8636	
alpha	4.6857	4.6956	4.7053	4.7515	4.7603	4.8018	4.8018	4.8096	4.7857	4.7603	4.7426	4.7242	
util living area													
	0.9989	0.9967	0.9896	0.9614	0.8772	0.7131	0.5476	0.6160	0.8643	0.9816	0.9974	0.9992	(86)
MIT	19.5510	19.7361	20.0332	20.4231	20.7523	20.9363	20.9856	20.9756	20.8321	20.3936	19.9001	19.5241	(87)
Th 2	19.8754	19.8780	19.8806	19.8928	19.8951	19.9058	19.9058	19.9078	19.9017	19.8951	19.8905	19.8857	(88)
util rest of house													
	0.9985	0.9955	0.9857	0.9462	0.8300	0.6173	0.4197	0.4845	0.7936	0.9718	0.9962	0.9989	(89)
MIT 2	17.9434	18.2157	18.6495	19.2143	19.6527	19.8639	19.9007	19.8979	19.7645	19.1829	18.4646	17.9112	(90)
Living area fraction										fLA = Living area / (4) =		0.1131	(91)
MIT	18.1251	18.3876	18.8060	19.3510	19.7770	19.9851	20.0234	20.0197	19.8852	19.3198	18.6269	18.0935	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1251	18.3876	18.8060	19.3510	19.7770	19.9851	20.0234	20.0197	19.8852	19.3198	18.6269	18.0935	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9974	0.9931	0.9802	0.9364	0.8240	0.6249	0.4339	0.4988	0.7923	0.9644	0.9942	0.9981	(94)
Useful gains	790.4834	970.6775	1140.6962	1277.1120	1242.7638	939.2038	621.8481	650.4774	916.0880	926.2723	796.3563	738.5343	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2618.7525	2548.0077	2318.6928	1944.8929	1499.5888	988.9138	628.6559	663.3559	1066.8974	1618.9316	2150.2477	2604.4905	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1360.2322	1059.9659	876.4295	480.8023	191.0778	0.0000	0.0000	0.0000	0.0000	515.3385	974.8018	1388.2714	(98)
Space heating												6846.9194	(98)
Space heating per m2											(98) / (4) =	45.4040	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												7322.9084	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1360.2322	1059.9659	876.4295	480.8023	191.0778	0.0000	0.0000	0.0000	0.0000	515.3385	974.8018	1388.2714	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1454.7938	1133.6534	937.3577	514.2270	204.3613	0.0000	0.0000	0.0000	0.0000	551.1642	1042.5688	1484.7823	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	221.2622	194.9983	204.7371	183.4581	179.7286	160.5161	154.0843	169.1807	168.9140	190.2392	201.2529	215.9134	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8335	88.6530	88.2590	87.2683	84.9773	79.8000	79.8000	79.8000	79.8000	87.3424	88.4700	88.8957	(217)
Fuel for water heating, kWh/month													
	249.0751	219.9569	231.9730	210.2232	211.5020	201.1480	193.0882	212.0058	211.6716	217.8086	227.4814	242.8840	(219)
Water heating fuel used												2628.8179	(219)
Annual totals kWh/year													
Space heating fuel - main system												7322.9084	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Total delivered energy for all uses												10533.6669	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7322.9084	0.2160	1581.7482	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2628.8179	0.2160	567.8247	(264)
Space and water heating			2149.5729	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Total CO2, kg/m2/year			2451.6001	(272)
Emissions per m2 for space and water heating			14.2545	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.7447	(272b)
Emissions per m2 for pumps and fans			0.2581	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2545 * 1.00) + 1.7447 + 0.2581, rounded to 2 d.p.			16.2600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1026	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3531	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3531	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4503	0.4414	0.4326	0.3885	0.3796	0.3355	0.3355	0.3267	0.3531	0.3796	0.3973	0.4149	(22b)
Effective ac	0.6014	0.5974	0.5936	0.5754	0.5721	0.5563	0.5563	0.5534	0.5624	0.5721	0.5789	0.5861	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21225.6360 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.7536 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.3040 (36)
Total fabric heat loss	(33) + (36) =	117.9023 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3382	76.8320	76.3358	74.0053	73.5693	71.5395	71.5395	71.1636	72.3213	73.5693	74.4514	75.3735	(38)
Heat transfer coeff	195.2405	194.7343	194.2381	191.9076	191.4716	189.4418	189.4418	189.0659	190.2236	191.4716	192.3537	193.2759	(39)
Average = Sum(39)m / 12 =												191.9055	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2947	1.2913	1.2881	1.2726	1.2697	1.2562	1.2562	1.2538	1.2614	1.2697	1.2756	1.2817	(40)
HLP (average)												1.2726	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Daily hot water use
            114.3081   110.1514   105.9948   101.8381    97.6815    93.5248    93.5248    97.6815   101.8381   105.9948   110.1514   114.3081 (44)
Energy conte   169.5156   148.2594   152.9905   133.3808   127.9820   110.4388   102.3378   117.4341   118.8366   138.4926   151.1755   164.1668 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1635.0105 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage loss
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Heat gains from water heating, kWh/month
                36.0221    31.5051    32.5105    28.3434    27.1962    23.4682    21.7468    24.9547    25.2528    29.4297    32.1248    34.8854 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          146.7715   146.7715   146.7715   146.7715   146.7715   146.7715   146.7715   146.7715   146.7715   146.7715   146.7715   146.7715 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                28.7051    25.4956    20.7344    15.6973    11.7339     9.9063    10.7041    13.9135    18.6747    23.7119    27.6752    29.5029 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               321.3914   324.7265   316.3223   298.4308   275.8459   254.6194   240.4387   237.1037   245.5079   263.3994   285.9842   307.2108 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                37.6771    37.6771    37.6771    37.6771    37.6771    37.6771    37.6771    37.6771    37.6771    37.6771    37.6771    37.6771 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172 (71)
Water heating gains (Table 5)
                48.4168    46.8826    43.6969    39.3659    36.5540    32.5948    29.2295    33.5413    35.0733    39.5560    44.6178    46.8890 (72)
Total internal gains
               465.5447   464.1362   447.7850   420.5254   391.1653   364.1519   347.4038   351.5900   366.2874   393.6987   425.3087   450.6342 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux             g               FF            Access            Gains
                                         m2             Table 6a       Specific data   Specific data      factor                W
                                                           W/m2        or Table 6b     or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------------
Northeast                              15.4000           11.2829           0.4600          0.0000           0.7700          61.5448 (75)
Southeast                               2.0700           36.7938           0.4600          0.0000           0.7700          26.9770 (77)
Southwest                               5.1500           36.7938           0.4600          0.0000           0.7700          67.1167 (79)
Southwest                               9.4900           36.7938           0.4600          0.0000           0.7700         123.6772 (79)
-------------------------------------------------------------------------------------------------------

Solar gains    279.3158   496.2209   733.2506   999.5472  1202.6498  1230.4941  1171.1208  1014.0107   824.5900   563.0703   338.2788   236.6272 (83)
Total gains    744.8605   960.3570  1181.0356  1420.0726  1593.8151  1594.6460  1518.5246  1365.6007  1190.8774   956.7691   763.5875   687.2614 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            30.1987    30.2772    30.3545    30.7232    30.7931    31.1231    31.1231    31.1849    30.9952    30.7931    30.6519    30.5057
alpha           3.0132     3.0185     3.0236     3.0482     3.0529     3.0749     3.0749     3.0790     3.0663     3.0529     3.0435     3.0337
util living area
                0.9910     0.9803     0.9567     0.8995     0.7933     0.6436     0.5060     0.5683     0.7894     0.9416     0.9841     0.9929 (86)

MIT            18.6929    18.9917    19.4547    20.0388    20.5246    20.8281    20.9398    20.9135    20.6563    19.9959    19.2328    18.6460 (87)
Th 2           19.8450    19.8476    19.8502    19.8624    19.8646    19.8753    19.8753    19.8772    19.8712    19.8646    19.8600    19.8552 (88)
util rest of house
                0.9890     0.9761     0.9473     0.8768     0.7459     0.5614     0.3928     0.4537     0.7226     0.9238     0.9801     0.9914 (89)
MIT 2          17.7428    18.0411    18.4993    19.0724    19.5199    19.7790    19.8531    19.8423    19.6522    19.0451    18.2916    17.7034 (90)
Living area fraction                                                                                    fLA = Living area / (4) =     0.1131 (91)
MIT            17.8502    18.1485    18.6073    19.1816    19.6335    19.8976    19.9759    19.9634    19.7657    19.1526    18.3980    17.8100 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT   17.8502    18.1485    18.6073    19.1816    19.6335    19.8976    19.9759    19.9634    19.7657    19.1526    18.3980    17.8100 (93)


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8. Space heating requirement
-------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9841     0.9676     0.9338     0.8602     0.7349     0.5632     0.4036     0.4633     0.7153     0.9091     0.9727     0.9874 (94)
Useful gains   733.0425   929.2379  1102.8812  1221.6124  1171.2560   898.0263   612.8334   632.6508   851.7785   869.8111   742.7540   678.5686 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             2645.5556  2579.9461  2351.7010  1973.1248  1519.0344  1003.5866   639.5419   673.7126  1077.7525  1637.5772  2173.2094  2630.4755 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             1422.9098  1109.2759   929.1219   541.0889   258.7472     0.0000     0.0000     0.0000     0.0000   571.2180  1029.9279  1452.2187 (98)
Space heating                                                                                                                       7314.5083 (98)
Space heating per m2                                                                                                  (98) / (4) =    48.5047 (99)


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8c. Space cooling requirement
-------------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1780.7527	1401.8691	1436.9007	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7948	0.8548	0.8183	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1415.2655	1198.2950	1175.8181	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1989.8859	1897.9526	1721.6752	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	413.7266	520.5453	406.1177	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1340.3896	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	103.4317	130.1363	101.5294	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												335.0974	(107)
Space cooling per m2												2.2221	(108)
Energy for space heating												48.5047	(99)
Energy for space cooling												2.2221	(108)
Total												50.7268	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1026	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3526	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3526	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4496	0.4408	0.4320	0.3879	0.3791	0.3350	0.3350	0.3262	0.3526	0.3791	0.3967	0.4144	(22b)
Effective ac	0.6011	0.5972	0.5933	0.5752	0.5719	0.5561	0.5561	0.5532	0.5622	0.5719	0.5787	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			32.1100	1.3258	42.5701			(27)
GF B&B J150 P/A=0.50			76.5900	0.1300	9.9567			(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.1800	24.6510			(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.1800	4.1526			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	2.3500		2.3500	0.1300	0.3055			(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9692			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.1491	(36)
Total fabric heat loss					(33) + (36) =		112.1183	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3013	76.7965	76.3018	73.9778	73.5430	71.5190	71.5190	71.1441	72.2986	73.5430	74.4226	75.3422	(38)
Heat transfer coeff	189.4196	188.9148	188.4201	186.0961	185.6613	183.6373	183.6373	183.2624	184.4169	185.6613	186.5409	187.4605	(39)
Average = Sum(39)m / 12 =												186.0940	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2561	1.2528	1.2495	1.2341	1.2312	1.2178	1.2178	1.2153	1.2229	1.2312	1.2370	1.2431	(40)
HLP (average)												1.2340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354	(42)
Average daily hot water use (litres/day)	103.9165	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

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Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	36.0221	31.5051	32.5105	28.3434	27.1962	23.4682	21.7468	24.9547	25.2528	29.4297	32.1248	34.8854	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	146.7715	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.7051	25.4956	20.7344	15.6973	11.7339	9.9063	10.7041	13.9135	18.6747	23.7119	27.6752	29.5029	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3914	324.7265	316.3223	298.4308	275.8459	254.6194	240.4387	237.1037	245.5079	263.3994	285.9842	307.2108	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	37.6771	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	48.4168	46.8826	43.6969	39.3659	36.5540	32.5948	29.2295	33.5413	35.0733	39.5560	44.6178	46.8890	(72)
Total internal gains													
	465.5447	464.1362	447.7850	420.5254	391.1653	364.1519	347.4038	351.5900	366.2874	393.6987	425.3087	450.6342	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.6300	0.7000	0.7700	53.1025	(75)
Southeast	2.0700	36.7938	0.6300	0.7000	0.7700	23.2765	(77)
Southwest	14.6400	36.7938	0.6300	0.7000	0.7700	164.6220	(79)

Solar gains	241.0010	428.1523	632.6677	862.4354	1037.6776	1061.7024	1010.4736	874.9149	711.4778	485.8318	291.8758	204.1681	(83)
Total gains	706.5457	892.2885	1080.4527	1282.9608	1428.8429	1425.8543	1357.8774	1226.5049	1077.7651	879.5305	717.1845	654.8023	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2858	55.4336	55.5791	56.2732	56.4050	57.0267	57.0267	57.1433	56.7856	56.4050	56.1390	55.8636	
alpha	4.6857	4.6956	4.7053	4.7515	4.7603	4.8018	4.8018	4.8096	4.7857	4.7603	4.7426	4.7242	
util living area													
	0.9993	0.9978	0.9923	0.9691	0.8945	0.7393	0.5741	0.6474	0.8881	0.9870	0.9984	0.9995	(86)
MIT	19.4987	19.6849	19.9846	20.3814	20.7247	20.9255	20.9825	20.9699	20.8062	20.3477	19.8493	19.4722	(87)
Th 2	19.8754	19.8780	19.8806	19.8928	19.8951	19.9058	19.9058	19.9078	19.9017	19.8951	19.8905	19.8857	(88)
util rest of house													
	0.9991	0.9970	0.9893	0.9564	0.8513	0.6443	0.4418	0.5127	0.8241	0.9798	0.9977	0.9994	(89)
MIT 2	18.5041	18.6920	18.9923	19.3907	19.7079	19.8716	19.9015	19.8992	19.7900	19.3649	18.8664	18.4857	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	18.6166	18.8043	19.1045	19.5027	19.8228	19.9907	20.0237	20.0202	19.9049	19.4760	18.9775	18.5972	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6166	18.8043	19.1045	19.5027	19.8228	19.9907	20.0237	20.0202	19.9049	19.4760	18.9775	18.5972	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9958	0.9865	0.9506	0.8479	0.6524	0.4568	0.5276	0.8244	0.9759	0.9968	0.9991	(94)
Useful gains	705.5880	888.5784	1065.8136	1219.5871	1211.5537	930.2721	620.2494	647.1368	888.4666	858.3156	714.8767	654.1860	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2711.8357	2626.7247	2374.9335	1973.1179	1508.0979	989.9376	628.7156	663.4531	1070.5234	1647.9319	2215.6471	2698.9098	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1492.6483	1168.0343	973.9852	542.5422	220.6289	0.0000	0.0000	0.0000	0.0000	587.4745	1080.5547	1521.2745	(98)
Space heating												7587.1425	(98)
Space heating per m2											(98) / (4) =	50.3126	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1726.1902	1358.9157	1392.7944	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8429	0.9075	0.8710	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1454.9678	1233.2765	1213.1424	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1792.5969	1710.1831	1559.0957	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000   243.0929   354.8186   257.3892     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          855.3007 (104)
Cooled fraction                                                                                          fC = cooled area / (4) =       1.0000 (105)
Intermittency factor (Table 10b)
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000    60.7732    88.7046    64.3473     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          213.8252 (107)
Space cooling per m2                                                                                                                     1.4179 (108)
Energy for space heating                                                                                                                50.3126 (99)
Energy for space cooling                                                                                                                 1.4179 (108)
Total                                                                                                                                   51.7306 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                     59.5 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b)	= 194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c)	= 195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3788	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3788	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3977	0.3788	0.3788	0.3504	0.3504	0.3125	0.3220	0.3030	0.3125	0.3315	0.3315	0.3599	(22b)
Effective ac	0.5791	0.5717	0.5717	0.5614	0.5614	0.5488	0.5518	0.5459	0.5488	0.5549	0.5549	0.5647	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	74.4747	73.5290	73.5290	72.1969	72.1969	70.5822	70.9686	70.2074	70.5822	71.3665	71.3665	72.6294	(38)
Heat transfer coeff	192.3771	191.4313	191.4313	190.0992	190.0992	188.4845	188.8709	188.1097	188.4845	189.2688	189.2688	190.5317	(39)
Average = Sum(39)m / 12 =												189.8714	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2757	1.2694	1.2694	1.2606	1.2606	1.2499	1.2525	1.2474	1.2499	1.2551	1.2551	1.2635	(40)
HLP (average)												1.2591	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Daily hot water use
              114.3081   110.1514   105.9948   101.8381    97.6815    93.5248    93.5248    97.6815   101.8381   105.9948   110.1514   114.3081 (44)
Energy conte  169.5156   148.2594   152.9905   133.3808   127.9820   110.4388   102.3378   117.4341   118.8366   138.4926   151.1755   164.1668 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =  1635.0105 (45)
Distribution loss  (46)m = 0.15 x (45)m
                25.4273    22.2389    22.9486    20.0071    19.1973    16.5658    15.3507    17.6151    17.8255    20.7739    22.6763    24.6250 (46)
Water storage loss:
Store volume                                                                                                                                210.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                 1.5400 (48)
  Temperature factor from Table 2b                                                                                                          0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                  0.8316 (55)
Total storage loss
                25.7796    23.2848    25.7796    24.9480    25.7796    24.9480    25.7796    25.7796    24.9480    25.7796    24.9480    25.7796 (56)
If cylinder contains dedicated solar storage
                25.7796    23.2848    25.7796    24.9480    25.7796    24.9480    25.7796    25.7796    24.9480    25.7796    24.9480    25.7796 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              218.5576   192.5554   202.0325   180.8408   177.0240   157.8988   151.3798   166.4761   166.2966   187.5346   198.6355   213.2088 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
              218.5576   192.5554   202.0325   180.8408   177.0240   157.8988   151.3798   166.4761   166.2966   187.5346   198.6355   213.2088 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =  2212.4405 (64)
RHI water heating demand                                                                                                                    2212 (64)
Heat gains from water heating, kWh/month
                95.5975    84.7331    90.1029    82.3171    81.7876    74.6889    73.2609    78.2804    77.4812    85.2824    88.2339    93.8191 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                71.7627    63.7390    51.8360    39.2432    29.3348    24.7656    26.7601    34.7839    46.6868    59.2796    69.1881    73.7572 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              479.6887   484.6664   472.1228   445.4191   411.7104   380.0289   358.8638   353.8861   366.4297   393.1335   426.8422   458.5236 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172 (71)
Water heating gains (Table 5)
              128.4913   126.0909   121.1061   114.3293   109.9296   103.7346    98.4690   105.2156   107.6127   114.6269   122.5470   126.1009 (72)
Total internal gains
              797.1993   791.7528   762.3215   716.2482   668.2313   625.7858   601.3495   611.1422   637.9858   684.2966   735.8339   775.6383 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	12.9236	0.4600	0.0000	0.7700	70.4939	(75)
Southeast	2.0700	40.4699	0.4600	0.0000	0.7700	29.6723	(77)
Southwest	5.1500	40.4699	0.4600	0.0000	0.7700	73.8224	(79)
Southwest	9.4900	40.4699	0.4600	0.0000	0.7700	136.0339	(79)

```
Solar gains   310.0224   496.8396   728.7297  1029.4720  1210.8144  1327.1599  1248.9516  1103.2441   890.3592   602.9338   384.8972   259.9645 (83)
Total gains  1107.2218  1288.5925  1491.0513  1745.7202  1879.0458  1952.9456  1850.3011  1714.3863  1528.3450  1287.2303  1120.7311  1035.6028 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          30.6482    30.7996    30.7996    31.0154    31.0154    31.2811    31.2171    31.3435    31.2811    31.1515    31.1515    30.9450
alpha         3.0432     3.0533     3.0533     3.0677     3.0677     3.0854     3.0811     3.0896     3.0854     3.0768     3.0768     3.0630
util living area
                0.9706     0.9534     0.9130     0.8204     0.6696     0.4548     0.3101     0.3420     0.6182     0.8606     0.9495     0.9751 (86)

MIT          19.1759    19.4166    19.8561    20.3742    20.7576    20.9498    20.9892    20.9855    20.8626    20.3794    19.7092    19.1372 (87)
Th 2         19.8599    19.8649    19.8649    19.8718    19.8718    19.8803    19.8783    19.8823    19.8803    19.8762    19.8762    19.8696 (88)
util rest of house
                0.9645     0.9440     0.8951     0.7843     0.6052     0.3630     0.2008     0.2266     0.5271     0.8231     0.9374     0.9699 (89)
MIT 2        17.4745    17.8225    18.4467    19.1600    19.6433    19.8498    19.8753    19.8780    19.7765    19.1899    18.2552    17.4249 (90)
Living area fraction                                                                                             fLA = Living area / (4) =     0.1131 (91)
MIT          17.6669    18.0027    18.6061    19.2973    19.7692    19.9741    20.0013    20.0032    19.8993    19.3243    18.4196    17.6185 (92)
Temperature adjustment                                                                                                                      -0.1500
adjusted MIT 17.5169    17.8527    18.4561    19.1473    19.6192    19.8241    19.8513    19.8532    19.7493    19.1743    18.2696    17.4685 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9459     0.9206     0.8663     0.7568     0.5893     0.3581     0.1981     0.2235     0.5153     0.7937     0.9130     0.9532 (94)
Useful gains  1047.3252  1186.3128  1291.6245  1321.1224  1107.2676   699.4311   366.4904   383.2245   787.6146  1021.6959  1023.1983   987.1079 (95)
Ext temp.        5.1000     5.6000     7.4000     9.9000    13.0000    16.0000    17.9000    17.8000    15.2000    11.6000     8.0000     5.1000 (96)
Heat loss rate W
              2388.7258  2345.5494  2116.4763  1757.9088  1258.3137   720.7930   368.5391   386.2249   857.4730  1433.5879  1943.7126  2356.5893 (97)
```

CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	998.0020	779.0070	613.6897	314.4862	112.3784	0.0000	0.0000	0.0000	0.0000	306.4477	662.7703	1018.8941 (98)
Space heating												4805.6755 (98)
RHI space heating demand												4806 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b) =	194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3788	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3788	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4830	0.4735	0.4640	0.4167	0.4072	0.3599	0.3599	0.3504	0.3788	0.4072	0.4262	0.4451	(22b)
Effective ac	0.6166	0.6121	0.6077	0.5868	0.5829	0.5647	0.5647	0.5614	0.5717	0.5829	0.5908	0.5991	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.3015	78.7190	78.1481	75.4666	74.9649	72.6294	72.6294	72.1969	73.5290	74.9649	75.9799	77.0409	(38)
Heat transfer coeff	197.2038	196.6214	196.0505	193.3689	192.8672	190.5317	190.5317	190.0992	191.4313	192.8672	193.8822	194.9432	(39)
Average = Sum(39)m / 12 =												193.3665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3077	1.3039	1.3001	1.2823	1.2790	1.2635	1.2635	1.2606	1.2694	1.2790	1.2857	1.2927	(40)
HLP (average)												1.2823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use

	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081 (44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668 (45)
Energy content (annual)										Total = Sum(45)m =		1635.0105 (45)

Distribution loss (46)m = 0.15 x (45)m

	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250 (46)

Water storage loss:

Store volume	210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5400 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.8316 (55)

Total storage loss

	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796 (56)

If cylinder contains dedicated solar storage

	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Total heat required for water heating calculated for each month

	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088 (64)
								Total per year (kWh/year) = Sum(64)m =				2212.4405 (64)

Heat gains from water heating, kWh/month

	95.5975	84.7331	90.1029	82.3171	81.7876	74.6889	73.2609	78.2804	77.4812	85.2824	88.2339	93.8191 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	71.7627	63.7390	51.8360	39.2432	29.3348	24.7656	26.7601	34.7839	46.6868	59.2796	69.1881	73.7572 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	479.6887	484.6664	472.1228	445.4191	411.7104	380.0289	358.8638	353.8861	366.4297	393.1335	426.8422	458.5236 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172 (71)

Water heating gains (Table 5)

	128.4913	126.0909	121.1061	114.3293	109.9296	103.7346	98.4690	105.2156	107.6127	114.6269	122.5470	126.1009 (72)

Total internal gains

	797.1993	791.7528	762.3215	716.2482	668.2313	625.7858	601.3495	611.1422	637.9858	684.2966	735.8339	775.6383 (73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	11.2829	0.4600	0.0000	0.7700	61.5448	(75)
Southeast	2.0700	36.7938	0.4600	0.0000	0.7700	26.9770	(77)
Southwest	5.1500	36.7938	0.4600	0.0000	0.7700	67.1167	(79)
Southwest	9.4900	36.7938	0.4600	0.0000	0.7700	123.6772	(79)

Solar gains	279.3158	496.2209	733.2506	999.5472	1202.6498	1230.4941	1171.1208	1014.0107	824.5900	563.0703	338.2788	236.6272	(83)
Total gains	1076.5152	1287.9737	1495.5721	1715.7954	1870.8811	1856.2799	1772.4704	1625.1529	1462.5758	1247.3669	1074.1127	1012.2655	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8981	29.9866	30.0739	30.4910	30.5703	30.9450	30.9450	31.0154	30.7996	30.5703	30.4103	30.2448	
alpha	2.9932	2.9991	3.0049	3.0327	3.0380	3.0630	3.0630	3.0677	3.0533	3.0380	3.0274	3.0163	
util living area	0.9760	0.9589	0.9255	0.8541	0.7363	0.5809	0.4466	0.4977	0.7137	0.8953	0.9619	0.9798	(86)
MIT	18.9559	19.2385	19.6679	20.1977	20.6177	20.8699	20.9568	20.9394	20.7449	20.1834	19.4764	18.9106	(87)
Th 2	19.8348	19.8378	19.8408	19.8547	19.8574	19.8696	19.8696	19.8718	19.8649	19.8574	19.8521	19.8465	(88)
util rest of house	0.9712	0.9508	0.9106	0.8248	0.6839	0.4997	0.3421	0.3905	0.6394	0.8675	0.9530	0.9757	(89)
MIT 2	17.1408	17.5493	18.1639	18.9098	19.4621	19.7663	19.8471	19.8376	19.6377	18.9111	17.9066	17.0821	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	17.3460	17.7403	18.3339	19.0554	19.5927	19.8910	19.9725	19.9621	19.7629	19.0550	18.0841	17.2888	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1960	17.5903	18.1839	18.9054	19.4427	19.7410	19.8225	19.8121	19.6129	18.9050	17.9341	17.1388	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9545	0.9283	0.8822	0.7952	0.6623	0.4897	0.3375	0.3844	0.6204	0.8372	0.9312	0.9609	(94)
Useful gains	1027.5698	1195.6617	1319.4602	1364.3933	1239.0404	908.9811	598.1767	624.7879	907.4529	1044.2749	1000.2515	972.6617	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2543.1447	2495.1821	2290.6409	1934.7322	1493.3217	979.5307	613.9932	648.6443	1055.3399	1601.7552	2100.5372	2522.3353	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating kWh

1127.5877	873.2777	722.5584	410.6440	189.1853	0.0000	0.0000	0.0000	0.0000	414.7653	792.2057	1152.9572	(98)

Space heating 5683.1814 (98)
Space heating per m2 (98) / (4) = 37.6869 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.6000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 6272.8271 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1127.5877	873.2777	722.5584	410.6440	189.1853	0.0000	0.0000	0.0000	0.0000	414.7653	792.2057	1152.9572	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1244.5780	963.8827	797.5259	453.2495	208.8138	0.0000	0.0000	0.0000	0.0000	457.7983	874.3992	1272.5796	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.6720	88.4598	88.0242	87.0364	85.0916	79.9000	79.9000	79.9000	79.9000	86.9735	88.2313	88.7453	(217)
Fuel for water heating, kWh/month													
	246.4786	217.6756	229.5192	207.7761	208.0394	197.6205	189.4615	208.3555	208.1309	215.6228	225.1305	240.2481	(219)
Water heating fuel used												2594.0588	(219)
Annual totals kWh/year													
Space heating fuel - main system												6272.8271	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Total delivered energy for all uses												9448.8265	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6272.8271	3.4800	218.2944	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2594.0588	3.4800	90.2732	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	506.9406	13.1900	66.8655	(250)
Additional standing charges			120.0000	(251)
Total energy cost			505.3256	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.0839 (257)
SAP value 84.8789
SAP rating (Section 12) 85 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6272.8271	0.2160	1354.9307	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.0588	0.2160	560.3167	(264)
Space and water heating			1915.2474	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Total kg/year			2217.2745	(272)
CO2 emissions per m2			14.7000	(273)
EI value			84.8256	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8507 = 4.091, stars = 4
Water heating environmental impact	0.216 / 0.8507 = 0.2539, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900 (1b)	x	2.5400 (2b)	=	194.5386	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3788	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3788	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3977	0.3788	0.3788	0.3504	0.3504	0.3125	0.3220	0.3030	0.3125	0.3315	0.3315	0.3599	(22b)
Effective ac	0.5791	0.5717	0.5717	0.5614	0.5614	0.5488	0.5518	0.5459	0.5488	0.5549	0.5549	0.5647	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21225.6360 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.7536 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.3040 (36)
Total fabric heat loss	(33) + (36) =	117.9023 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	74.4747	73.5290	73.5290	72.1969	72.1969	70.5822	70.9686	70.2074	70.5822	71.3665	71.3665	72.6294	(38)
Heat transfer coeff	192.3771	191.4313	191.4313	190.0992	190.0992	188.4845	188.8709	188.1097	188.4845	189.2688	189.2688	190.5317	(39)
Average = Sum(39)m / 12 =												189.8714	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2757	1.2694	1.2694	1.2606	1.2606	1.2499	1.2525	1.2474	1.2499	1.2551	1.2551	1.2635	(40)
HLP (average)												1.2591	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Daily hot water use													
	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081	(44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0105	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.4405	(64)
Heat gains from water heating, kWh/month													
	95.5975	84.7331	90.1029	82.3171	81.7876	74.6889	73.2609	78.2804	77.4812	85.2824	88.2339	93.8191	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.7627	63.7390	51.8360	39.2432	29.3348	24.7656	26.7601	34.7839	46.6868	59.2796	69.1881	73.7572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	479.6887	484.6664	472.1228	445.4191	411.7104	380.0289	358.8638	353.8861	366.4297	393.1335	426.8422	458.5236	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	128.4913	126.0909	121.1061	114.3293	109.9296	103.7346	98.4690	105.2156	107.6127	114.6269	122.5470	126.1009	(72)
Total internal gains													
	797.1993	791.7528	762.3215	716.2482	668.2313	625.7858	601.3495	611.1422	637.9858	684.2966	735.8339	775.6383	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	12.9236	0.4600	0.0000	0.7700	70.4939	(75)
Southeast	2.0700	40.4699	0.4600	0.0000	0.7700	29.6723	(77)
Southwest	5.1500	40.4699	0.4600	0.0000	0.7700	73.8224	(79)
Southwest	9.4900	40.4699	0.4600	0.0000	0.7700	136.0339	(79)

Solar gains	310.0224	496.8396	728.7297	1029.4720	1210.8144	1327.1599	1248.9516	1103.2441	890.3592	602.9338	384.8972	259.9645	(83)
Total gains	1107.2218	1288.5925	1491.0513	1745.7202	1879.0458	1952.9456	1850.3011	1714.3863	1528.3450	1287.2303	1120.7311	1035.6028	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.6482	30.7996	30.7996	31.0154	31.0154	31.2811	31.2171	31.3435	31.2811	31.1515	31.1515	30.9450	
alpha	3.0432	3.0533	3.0533	3.0677	3.0677	3.0854	3.0811	3.0896	3.0854	3.0768	3.0768	3.0630	
util living area													
	0.9706	0.9534	0.9130	0.8204	0.6696	0.4548	0.3101	0.3420	0.6182	0.8606	0.9495	0.9751	(86)
MIT	19.1759	19.4166	19.8561	20.3742	20.7576	20.9498	20.9892	20.9855	20.8626	20.3794	19.7092	19.1372	(87)
Th 2	19.8599	19.8649	19.8649	19.8718	19.8718	19.8803	19.8783	19.8823	19.8803	19.8762	19.8762	19.8696	(88)
util rest of house													
	0.9645	0.9440	0.8951	0.7843	0.6052	0.3630	0.2008	0.2266	0.5271	0.8231	0.9374	0.9699	(89)
MIT 2	17.4745	17.8225	18.4467	19.1600	19.6433	19.8498	19.8753	19.8780	19.7765	19.1899	18.2552	17.4249	(90)
Living area fraction										fLA = Living area / (4) =		0.1131	(91)
MIT	17.6669	18.0027	18.6061	19.2973	19.7692	19.9741	20.0013	20.0032	19.8993	19.3243	18.4196	17.6185	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5169	17.8527	18.4561	19.1473	19.6192	19.8241	19.8513	19.8532	19.7493	19.1743	18.2696	17.4685	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9459	0.9206	0.8663	0.7568	0.5893	0.3581	0.1981	0.2235	0.5153	0.7937	0.9130	0.9532	(94)
Useful gains	1047.3252	1186.3128	1291.6245	1321.1224	1107.2676	699.4311	366.4904	383.2245	787.6146	1021.6959	1023.1983	987.1079	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2388.7258	2345.5494	2116.4763	1757.9088	1258.3137	720.7930	368.5391	386.2249	857.4730	1433.5879	1943.7126	2356.5893	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating kWh

	998.0020	779.0070	613.6897	314.4862	112.3784	0.0000	0.0000	0.0000	0.0000	306.4477	662.7703	1018.8941 (98)
Space heating												4805.6755 (98)
Space heating per m2											(98) / (4) =	31.8679 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.6000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	5304.2776 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	998.0020	779.0070	613.6897	314.4862	112.3784	0.0000	0.0000	0.0000	0.0000	306.4477	662.7703	1018.8941	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1101.5475	859.8311	677.3618	347.1150	124.0379	0.0000	0.0000	0.0000	0.0000	338.2425	731.5346	1124.6072	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5576	192.5554	202.0325	180.8408	177.0240	157.8988	151.3798	166.4761	166.2966	187.5346	198.6355	213.2088	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.4715	88.2575	87.6915	86.3768	83.7404	79.9000	79.9000	79.9000	79.9000	86.2167	87.8860	88.5480	(217)
Fuel for water heating, kWh/month													
	247.0373	218.1745	230.3901	209.3626	211.3963	197.6205	189.4615	208.3555	208.1309	217.5153	226.0149	240.7833	(219)
Water heating fuel used												2604.2429	(219)
Annual totals kWh/year													
Space heating fuel - main system												5304.2776	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Total delivered energy for all uses												8490.4611	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5304.2776	3.9200	207.9277	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2604.2429	3.9200	102.0863	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	506.9406	16.9600	85.9771	(250)
Additional standing charges			88.0000	(251)
Total energy cost			496.7111	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5304.2776	0.2160	1145.7240	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2604.2429	0.2160	562.5165	(264)
Space and water heating			1708.2404	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Total kg/year			2010.2676	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5304.2776	1.2200	6471.2186	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2604.2429	1.2200	3177.1763	(264)
Space and water heating			9648.3950	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	506.9406	3.0700	1556.3077	(268)
Primary energy kWh/year			11434.9527	(272)
Primary energy kWh/m2/year			75.8286	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 85
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 44	-265 kg (13.2%)
U Solar photovoltaic panels	+ 6.8	-£ 309	-947 kg (54.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.76 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	6.28 kg/m²	A 93	A 93
Total Savings	£354	8.04 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£99	£107	-£8
Mains gas	£398	£345	£53
Space heating	£309	£310	-£1
Water heating	£102	£56	£46
Lighting	£86	£86	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£497	£143	£354
Total cost of uses	£497	£143	£354
Delivered energy	56 kWh/m²	36 kWh/m²	21 kWh/m²
Carbon dioxide emissions	2.0 tonnes	0.8 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	5 kg/m²	8 kg/m²
Primary energy	76 kWh/m²	29 kWh/m²	47 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b) =	194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3788	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3788	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4830	0.4735	0.4640	0.4167	0.4072	0.3599	0.3599	0.3504	0.3788	0.4072	0.4262	0.4451	(22b)
Effective ac	0.6166	0.6121	0.6077	0.5868	0.5829	0.5647	0.5647	0.5614	0.5717	0.5829	0.5908	0.5991	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21225.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	140.7536	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.3040	(36)
Total fabric heat loss	(33) + (36) = 117.9023	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.3015	78.7190	78.1481	75.4666	74.9649	72.6294	72.6294	72.1969	73.5290	74.9649	75.9799	77.0409	(38)
Heat transfer coeff	197.2038	196.6214	196.0505	193.3689	192.8672	190.5317	190.5317	190.0992	191.4313	192.8672	193.8822	194.9432	(39)
Average = Sum(39)m / 12 =												193.3665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3077	1.3039	1.3001	1.2823	1.2790	1.2635	1.2635	1.2606	1.2694	1.2790	1.2857	1.2927	(40)
HLP (average)												1.2823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Daily hot water use
              114.3081   110.1514   105.9948   101.8381    97.6815    93.5248    93.5248    97.6815   101.8381   105.9948   110.1514   114.3081 (44)
Energy conte   169.5156   148.2594   152.9905   133.3808   127.9820   110.4388   102.3378   117.4341   118.8366   138.4926   151.1755   164.1668 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1635.0105 (45)
Distribution loss  (46)m = 0.15 x (45)m
                25.4273    22.2389    22.9486    20.0071    19.1973    16.5658    15.3507    17.6151    17.8255    20.7739    22.6763    24.6250 (46)
Water storage loss:
Store volume                                                                                                                                 210.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                  1.5400 (48)
  Temperature factor from Table 2b                                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                     0.8316 (55)
Total storage loss
                25.7796    23.2848    25.7796    24.9480    25.7796    24.9480    25.7796    25.7796    24.9480    25.7796    24.9480    25.7796 (56)
If cylinder contains dedicated solar storage
                16.5726    14.9688    16.5726    16.0380    16.5726    16.0380    16.5726    16.5726    16.0380    16.5726    16.0380    16.5726 (57)
Primary loss    23.2624    21.0112    21.8667    15.7584    10.4681     9.9053    10.2355    11.1660    17.1091    21.8667    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              209.3506   184.2394   191.4297   165.1772   155.0227   136.3821   129.1458   145.1726   151.9837   176.9319   189.7255   204.0018 (62)
Aperture area of solar collector                                                                                                               3.0000 (H1)
Zero-loss collector efficiency                                                                                                                 0.7000 (H2)
Collector heat loss coefficient                                                                                                                1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                                      0.0050 (H3a)
Collector effective heat loss coefficient                                                                                                      1.8063 (H3b)
Collector performance ratio                                                                                                                    2.5804 (H4)
Annual solar radiation per m2                                                                                                               1079.5246 (H5)
Overshading factor                                                                                                                             0.8000 (H6)
Solar energy available                                                                                                                      1813.6014 (H7)
Adjustment factor for showers                                                                                                                  1.0000 (H7a)
Solar-to-load ratio                                                                                                                            1.1092 (H8)
Utilisation factor                                                                                                                             0.5941 (H9)
Collector performance factor                                                                                                                   0.8793 (H10)
Dedicated solar storage volume                                                                                                                75.0000 (H11)
Effective solar volume                                                                                                                       115.5000 (H13)
Daily hot water demand                                                                                                                       103.9165 (H14)
Volume ratio Veff/V                                                                                                                            1.1115 (H15)
Solar storage volume factor                                                                                                                    1.0000 (H16)
Solar input                                                                                                                                 -947.3254 (H17)
Solar input    -27.4705   -45.8404   -78.0715  -104.6312  -129.2631  -127.0862  -125.4067  -109.5685   -85.8141   -58.6009   -32.5840   -22.9882 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =  -947.3254 (63)
Output from w/h
              181.8801   138.3990   113.3582    60.5460    25.7597     9.2959     3.7391    35.6042    66.1697   118.3310   157.1415   181.0137 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =  1091.2378 (64)
Heat gains from water heating, kWh/month
                88.2319    78.0803    81.6207    69.7862    64.1866    57.4755    55.4737    61.2377    66.0309    76.8002    81.1059    86.4535 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258   176.1258 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                71.7627    63.7390    51.8360    39.2432    29.3348    24.7656    26.7601    34.7839    46.6868    59.2796    69.1881    73.7572 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              479.6887   484.6664   472.1228   445.4191   411.7104   380.0289   358.8638   353.8861   366.4297   393.1335   426.8422   458.5236 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480    55.5480 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172  -117.4172 (71)
Water heating gains (Table 5)
              118.5913   116.1909   109.7053    96.9253    86.2723    79.8271    74.5615    82.3087    91.7095   103.2261   112.6470   116.2009 (72)
Total internal gains
              787.2993   781.8528   750.9207   698.8442   644.5740   601.8783   577.4420   588.2353   622.0826   672.8958   725.9339   765.7383 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data      factor              W
                                                         W/m2         or Table 6b      or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
Northeast                              15.4000          11.2829           0.4600           0.0000           0.7700          61.5448 (75)
Southeast                               2.0700          36.7938           0.4600           0.0000           0.7700          26.9770 (77)
Southwest                               5.1500          36.7938           0.4600           0.0000           0.7700          67.1167 (79)
Southwest                               9.4900          36.7938           0.4600           0.0000           0.7700         123.6772 (79)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    279.3158   496.2209   733.2506   999.5472  1202.6498  1230.4941  1171.1208  1014.0107   824.5900   563.0703   338.2788   236.6272 (83)
Total gains   1066.6152  1278.0737  1484.1713  1698.3914  1847.2238  1832.3724  1748.5629  1602.2460  1446.6726  1235.9661  1064.2127  1002.3655 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                   21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           29.8981    29.9866    30.0739    30.4910    30.5703    30.9450    30.9450    31.0154    30.7996    30.5703    30.4103    30.2448
alpha          2.9932     2.9991     3.0049     3.0327     3.0380     3.0630     3.0630     3.0677     3.0533     3.0380     3.0274     3.0163
util living area
                0.9766     0.9597     0.9268     0.8570     0.7412     0.5864     0.4518     0.5035     0.7180     0.8973     0.9628     0.9803 (86)

MIT           18.9477    19.2307    19.6599    20.1885    20.6100    20.8664    20.9554    20.9375    20.7402    20.1763    19.4685    18.9021 (87)
Th 2          19.8348    19.8378    19.8408    19.8547    19.8574    19.8696    19.8696    19.8718    19.8649    19.8574    19.8521    19.8465 (88)
util rest of house
                0.9719     0.9517     0.9121     0.8280     0.6891     0.5050     0.3464     0.3955     0.6440     0.8699     0.9541     0.9763 (89)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.1289	17.5382	18.1529	18.8977	19.4533	19.7632	19.8463	19.8363	19.6330	18.9017	17.8954	17.0700	(90)
Living area fraction									fLA = Living area / (4) =			0.1131	(91)
MIT	17.3345	17.7296	18.3233	19.0436	19.5841	19.8879	19.9717	19.9608	19.7582	19.0459	18.0733	17.2771	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1845	17.5796	18.1733	18.8936	19.4341	19.7379	19.8217	19.8108	19.6082	18.8959	17.9233	17.1271	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9554	0.9294	0.8838	0.7983	0.6671	0.4947	0.3417	0.3893	0.6247	0.8396	0.9325	0.9617	(94)
Useful gains	1019.0801	1187.8716	1311.7592	1355.7665	1232.3051	906.4299	597.4619	623.7102	903.7803	1037.6972	992.3943	963.9985	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2540.8801	2493.0818	2288.5539	1932.4587	1491.6488	978.9405	613.8274	648.3945	1054.4410	1599.9982	2098.4399	2520.0520	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1132.2192	877.1013	726.7352	415.2184	192.9517	0.0000	0.0000	0.0000	0.0000	418.3519	796.3528	1157.7038	(98)
Space heating												5716.6344	(98)
Space heating per m2											(98) / (4) =	37.9087	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6309.7509	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1132.2192	877.1013	726.7352	415.2184	192.9517	0.0000	0.0000	0.0000	0.0000	418.3519	796.3528	1157.7038	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1249.6900	968.1029	802.1360	458.2984	212.9710	0.0000	0.0000	0.0000	0.0000	461.7571	878.9766	1277.8188	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	181.8801	138.3990	113.3582	60.5460	25.7597	9.2959	3.7391	35.6042	66.1697	118.3310	157.1415	181.0137	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.9513	88.9761	88.9919	89.0818	89.1932	79.9000	79.9000	79.9000	79.9000	88.0016	88.6436	88.9886	(217)
Fuel for water heating, kWh/month	204.4715	155.5463	127.3803	67.9667	28.8807	11.6344	4.6797	44.5609	82.8156	134.4646	177.2734	203.4121	(219)
Water heating fuel used												1243.0862	(219)
Annual totals kWh/year													
Space heating fuel - main system												6309.7509	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												6457.5384	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6309.7509	3.4800	219.5793	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1243.0862	3.4800	43.2594	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	506.9406	13.1900	66.8655	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			238.3688	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5113	(257)
SAP value		92.8672	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6309.7509	0.2160	1362.9062	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1243.0862	0.2160	268.5066	(264)
Space and water heating			1631.4128	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			1062.9528	(272)
CO2 emissions per m2			7.0500	(273)
EI value			92.7255	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.5900	(1b)	x 2.5400	(2b) =	194.5386	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		389.7109	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1283	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3788	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3788	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3977	0.3788	0.3788	0.3504	0.3504	0.3125	0.3220	0.3030	0.3125	0.3315	0.3315	0.3599	(22b)
Effective ac	0.5791	0.5717	0.5717	0.5614	0.5614	0.5488	0.5518	0.5459	0.5488	0.5549	0.5549	0.5647	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.6200	1.2357	27.9525			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.5900	0.1200	9.1908	75.0000	5744.2500	(28a)
EW Brick AAC015	169.0100	32.0600	136.9500	0.2500	34.2375	52.3000	7162.4850	(29a)
EW WBoard ACC015	27.3800	4.3100	23.0700	0.2400	5.5368	52.3000	1206.5610	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	2.3500		2.3500	0.1400	0.3290	9.0000	21.1500	(30)
Total net area of external elements Aum(A, m2)			349.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		106.5984			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21225.6360 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		140.7536 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.3040 (36)
Total fabric heat loss	(33) + (36) =	117.9023 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	74.4747	73.5290	73.5290	72.1969	72.1969	70.5822	70.9686	70.2074	70.5822	71.3665	71.3665	72.6294	(38)
Heat transfer coeff	192.3771	191.4313	191.4313	190.0992	190.0992	188.4845	188.8709	188.1097	188.4845	189.2688	189.2688	190.5317	(39)
Average = Sum(39)m / 12 =												189.8714	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2757	1.2694	1.2694	1.2606	1.2606	1.2499	1.2525	1.2474	1.2499	1.2551	1.2551	1.2635	(40)
HLP (average)												1.2591	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9354 (42)
Average daily hot water use (litres/day)	103.9165 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use

	114.3081	110.1514	105.9948	101.8381	97.6815	93.5248	93.5248	97.6815	101.8381	105.9948	110.1514	114.3081 (44)
Energy conte	169.5156	148.2594	152.9905	133.3808	127.9820	110.4388	102.3378	117.4341	118.8366	138.4926	151.1755	164.1668 (45)
Energy content (annual)										Total = Sum(45)m =		1635.0105 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.4273	22.2389	22.9486	20.0071	19.1973	16.5658	15.3507	17.6151	17.8255	20.7739	22.6763	24.6250 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8316 (55)
Total storage loss												
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796 (56)
If cylinder contains dedicated solar storage												
	16.5726	14.9688	16.5726	16.0380	16.5726	16.0380	16.5726	16.5726	16.0380	16.5726	16.0380	16.5726 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	209.3506	184.2394	191.4297	165.1772	155.0227	136.3821	129.1458	145.1726	151.9837	176.9319	189.7255	204.0018 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1140.0998 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1915.3676 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1715 (H8)
Utilisation factor												0.5741 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												103.9165 (H14)
Volume ratio Veff/V												1.1115 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-966.9372 (H17)
Solar input	-29.7618	-44.7320	-75.3343	-104.1351	-125.4137	-131.9925	-128.8231	-115.0398	-89.7890	-61.0818	-36.1763	-24.6579 (63)
								Solar input (sum of months) = Sum(63)m =				-966.9372 (63)
Output from w/h												
	179.5888	139.5074	116.0954	61.0421	29.6090	4.3896	0.3227	30.1328	62.1948	115.8501	153.5492	179.3439 (64)
								Total per year (kWh/year) = Sum(64)m =				1071.6259 (64)
Heat gains from water heating, kWh/month												
	88.2319	78.0803	81.6207	69.7862	64.1866	57.4755	55.4737	61.2377	66.0309	76.8002	81.1059	86.4535 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	176.1258	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.7627	63.7390	51.8360	39.2432	29.3348	24.7656	26.7601	34.7839	46.6868	59.2796	69.1881	73.7572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	479.6887	484.6664	472.1228	445.4191	411.7104	380.0289	358.8638	353.8861	366.4297	393.1335	426.8422	458.5236	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	55.5480	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	-117.4172	(71)
Water heating gains (Table 5)													
	118.5913	116.1909	109.7053	96.9253	86.2723	79.8271	74.5615	82.3087	91.7095	103.2261	112.6470	116.2009	(72)
Total internal gains													
	787.2993	781.8528	750.9207	698.8442	644.5740	601.8783	577.4420	588.2353	622.0826	672.8958	725.9339	765.7383	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	15.4000	12.9236	0.4600	0.0000	0.7700	70.4939	(75)
Southeast	2.0700	40.4699	0.4600	0.0000	0.7700	29.6723	(77)
Southwest	5.1500	40.4699	0.4600	0.0000	0.7700	73.8224	(79)
Southwest	9.4900	40.4699	0.4600	0.0000	0.7700	136.0339	(79)

Solar gains	310.0224	496.8396	728.7297	1029.4720	1210.8144	1327.1599	1248.9516	1103.2441	890.3592	602.9338	384.8972	259.9645	(83)
Total gains	1097.3218	1278.6925	1479.6505	1728.3162	1855.3884	1929.0382	1826.3936	1691.4794	1512.4418	1275.8295	1110.8311	1025.7028	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.6482	30.7996	30.7996	31.0154	31.0154	31.2811	31.2171	31.3435	31.2811	31.1515	31.1515	30.9450	
alpha	3.0432	3.0533	3.0533	3.0677	3.0677	3.0854	3.0811	3.0896	3.0854	3.0768	3.0768	3.0630	
util living area													
	0.9712	0.9543	0.9144	0.8236	0.6749	0.4596	0.3140	0.3463	0.6226	0.8630	0.9506	0.9757	(86)
MIT	19.1677	19.4089	19.8485	20.3661	20.7520	20.9483	20.9888	20.9850	20.8597	20.3731	19.7016	19.1289	(87)
Th 2	19.8599	19.8649	19.8649	19.8718	19.8718	19.8803	19.8783	19.8823	19.8803	19.8762	19.8762	19.8696	(88)
util rest of house													
	0.9653	0.9450	0.8968	0.7878	0.6106	0.3671	0.2033	0.2296	0.5315	0.8259	0.9387	0.9706	(89)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.4628	17.8116	18.4363	19.1498	19.6374	19.8488	19.8752	19.8778	19.7741	19.1820	18.2446	17.4129 (90)
Living area fraction										fLA = Living area / (4) =		0.1131 (91)
MIT	17.6556	17.9922	18.5960	19.2874	19.7635	19.9731	20.0011	20.0030	19.8968	19.3167	18.4093	17.6069 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5056	17.8422	18.4460	19.1374	19.6135	19.8231	19.8511	19.8530	19.7468	19.1667	18.2593	17.4569 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9218	0.8680	0.7601	0.5943	0.3621	0.2006	0.2265	0.5194	0.7964	0.9145	0.9541	(94)
Useful gains	1039.0863	1178.7381	1284.3613	1313.7319	1102.6545	698.5711	366.3875	383.0718	785.6282	1016.1155	1015.8209	978.6736	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2386.5533	2343.5395	2114.5425	1756.0139	1257.2147	720.5981	368.5126	386.1864	857.0087	1432.1349	1941.7655	2354.3887	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1002.5155	782.7465	617.6548	318.4430	114.9928	0.0000	0.0000	0.0000	0.0000	309.5184	666.6801	1023.5320	(98)
Space heating												4836.0832	(98)
Space heating per m2											(98) / (4) =	32.0695	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5337.8402	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1002.5155	782.7465	617.6548	318.4430	114.9928	0.0000	0.0000	0.0000	0.0000	309.5184	666.6801	1023.5320	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1106.5293	863.9587	681.7382	351.4823	126.9236	0.0000	0.0000	0.0000	0.0000	341.6318	735.8500	1129.7263	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.5888	139.5074	116.0954	61.0421	29.6090	4.3896	0.3227	30.1328	62.1948	115.8501	153.5492	179.3439	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7935	88.8011	88.7201	88.6895	88.1819	79.9000	79.9000	79.9000	79.9000	87.4119	88.3842	88.8264	(217)
Fuel for water heating, kWh/month	202.2544	157.1010	130.8557	68.8267	33.5772	5.4938	0.4039	37.7132	77.8408	132.5336	173.7292	201.9038	(219)
Water heating fuel used												1222.2334	(219)
Annual totals kWh/year													
Space heating fuel - main system												5337.8402	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.9406	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												5367.8546	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5337.8402	3.9200	209.2433	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1222.2334	3.9200	47.9116	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	506.9406	16.9600	85.9771	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			142.9545	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5337.8402	0.2160	1152.9735	(261)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1222.2334	0.2160	264.0024	(264)
Space and water heating			1416.9759	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.9406	0.5190	263.1022	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			798.2142	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5337.8402	1.2200	6512.1650	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1222.2334	1.2200	1491.1248	(264)
Space and water heating			8003.2898	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	506.9406	3.0700	1556.3077	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			4343.1774	(272)
Primary energy kWh/m2/year			28.8009	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	140.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		514.42 (P1)
Transmission heat loss coefficient		117.90 (37)
Summer heat loss coefficient		632.32 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	15.4000	98.8453	0.4600	0.0000	0.9000	630.1979
South East	2.0700	119.9223	0.4600	0.0000	0.9000	102.7711
South West	5.1500	119.9223	0.4600	0.0000	0.9000	255.6864
South West	9.4900	119.9223	0.4600	0.0000	0.9000	471.1581
total:						1459.8135

	Jun	Jul	Aug	
Solar gains	1551	1460	1290	(P4)
Internal gains	623	598	608	
Total summer gains	2174	2058	1898	(P5)
Summer gain/loss ratio	3.44	3.25	3.00	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 140.8)	1.01	1.01	1.01	
Threshold temperature	20.45	22.17	21.82	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-327	**Issued on Date**	19/10/2022
Assessment Reference	Plot 327	**Prop Type Ref**	Richmond-As-DET
Property	Plot 327, 4 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	16.48	**TER**	16.58
Environmental	85 B	**% DER<TER**	0.63		
CO_2 Emissions (t/year)	1.81	**DFEE**	49.31	**TFEE**	56.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.19		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 131 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.48 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.68 m², No overhang
Windows facing South West: 10.76 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.026 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4379	0.4279	0.3782	0.3782	0.3682	0.3981	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5916	0.5715	0.5715	0.5678	0.5792	0.5916	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.3102	69.7510	69.2028	66.6282	66.1465	63.9041	63.9041	63.4888	64.7678	66.1465	67.1210	68.1398	(38)
Heat transfer coeff	161.7594	161.2002	160.6521	158.0774	157.5957	155.3533	155.3533	154.9381	156.2171	157.5957	158.5702	159.5890	(39)
Average = Sum(39)m / 12 =												158.0751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2298	1.2256	1.2060	1.2023	1.1852	1.1852	1.1820	1.1918	1.2023	1.2097	1.2175	(40)
HLP (average)												1.2059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	521.4710	518.9998	501.5003	473.1227	443.8038	416.0943	398.4746	405.2546	420.1887	448.8016	481.6107	506.7017	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	692.3918	820.3361	940.8809	1062.9255	1145.8610	1131.2978	1080.4234	1000.6706	911.2226	789.1436	688.1910	651.7730	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2656	33.3810	33.4949	34.0405	34.1445	34.6374	34.6374	34.7302	34.4458	34.1445	33.9347	33.7180	
alpha	3.2177	3.2254	3.2330	3.2694	3.2763	3.3092	3.3092	3.3153	3.2964	3.2763	3.2623	3.2479	
util living area													
	0.9907	0.9832	0.9675	0.9291	0.8504	0.7161	0.5733	0.6257	0.8271	0.9505	0.9845	0.9923	(86)
MIT	18.9135	19.1461	19.5276	20.0351	20.4872	20.8069	20.9328	20.9091	20.6606	20.0720	19.4094	18.8848	(87)
Th 2	19.8929	19.8962	19.8996	19.9152	19.9182	19.9319	19.9319	19.9344	19.9266	19.9182	19.9122	19.9060	(88)
util rest of house													
	0.9886	0.9796	0.9600	0.9117	0.8107	0.6376	0.4563	0.5110	0.7668	0.9350	0.9805	0.9907	(89)
MIT 2	17.1063	17.4465	18.0010	18.7356	19.3583	19.7675	19.8940	19.8786	19.6023	18.8009	17.8416	17.0722	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.3079	17.6361	18.1712	18.8806	19.4842	19.8834	20.0099	19.9936	19.7204	18.9427	18.0164	17.2744	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1579	17.4861	18.0212	18.7306	19.3342	19.7334	19.8599	19.8436	19.5704	18.7927	17.8664	17.1244	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9804	0.9672	0.9415	0.8862	0.7845	0.6209	0.4476	0.5000	0.7420	0.9118	0.9685	0.9837	(94)
Useful gains	678.8492	793.4125	885.8393	941.9956	898.8970	702.4426	483.6390	500.3804	676.1673	719.5185	666.5398	641.1203	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2079.8835	2028.8773	1850.9090	1553.9936	1203.1128	797.4979	506.4313	533.5387	854.5655	1291.1340	1707.2360	2062.5842	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1042.3695	830.2323	718.0119	440.6386	226.3365	0.0000	0.0000	0.0000	0.0000	425.2819	749.3013	1057.5692	(98)
Space heating												5489.7412	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 41.8808 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6072.7225	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1042.3695	830.2323	718.0119	440.6386	226.3365	0.0000	0.0000	0.0000	0.0000	425.2819	749.3013	1057.5692	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1153.0636	918.3986	794.2609	487.4320	250.3723	0.0000	0.0000	0.0000	0.0000	470.4446	828.8731	1169.8774	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3796	88.2096	87.8552	87.0559	85.4352	79.7000	79.7000	79.7000	79.7000	86.8884	87.9686	88.4437	(217)
Fuel for water heating, kWh/month													
	242.0430	213.5882	224.8403	202.8740	202.1893	193.0607	184.8401	203.6183	203.5067	210.8001	220.8233	235.8721	(219)
Water heating fuel used												2538.0560	(219)
Annual totals kWh/year													
Space heating fuel - main system												6072.7225	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												9190.3115	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6072.7225	0.2160	1311.7081	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2538.0560	0.2160	548.2201	(264)
Space and water heating			1859.9282	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total CO2, kg/year			2160.7057	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.4800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.4800	ZC1
Total Floor Area	TFA	131.0800	
Assumed number of occupants	N	2.8977	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5178	ZC2
CO2 emissions from cooking, equation (L16)		1.4384	ZC3
Total CO2 emissions		31.4362	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.4362	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)

Water storage loss:	
Store volume	170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5003 (48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.8102 (55)
Total storage loss
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (56)
If cylinder contains dedicated solar storage
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2190.5335 (64)
Heat gains from water heating, kWh/month
               94.5805    83.8284    89.1333    81.4208    80.8896    73.8582    72.4363    77.4126    76.6265    84.3542    87.2865    92.8174 (65)
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)

Water heating gains (Table 5)

	127.1244	124.7446	119.8028	113.0844	108.7226	102.5809	97.3607	104.0492	106.4257	113.3794	121.2313	124.7545	(72)

Total internal gains

	524.1767	521.7055	504.2060	475.8284	446.5095	418.8000	401.1803	407.9603	422.8944	451.5073	484.3164	509.4074	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.6300	0.7000	0.7700	26.4823	(75)
Southwest	10.7600	36.7938	0.6300	0.7000	0.7700	120.9927	(79)

Solar gains	147.4750	260.0008	379.1091	508.8972	605.7533	617.0962	588.4032	513.7405	423.6768	293.6560	178.2429	125.1713	(83)
Total gains	671.6517	781.7063	883.3151	984.7257	1052.2628	1035.8962	989.5836	921.7007	846.5712	745.1633	662.5593	634.5787	(84)

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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5268	59.7135	59.8976	60.7779	60.9455	61.7379	61.7379	61.8869	61.4302	60.9455	60.6074	60.2580	
alpha	4.9685	4.9809	4.9932	5.0519	5.0630	5.1159	5.1159	5.1258	5.0953	5.0630	5.0405	5.0172	
util living area	0.9990	0.9977	0.9937	0.9785	0.9270	0.7951	0.6274	0.6870	0.9038	0.9872	0.9979	0.9993	(86)
MIT	19.6551	19.8032	20.0517	20.3911	20.7031	20.9137	20.9799	20.9687	20.8150	20.4130	19.9772	19.6366	(87)
Th 2	19.9468	19.9497	19.9526	19.9662	19.9687	19.9806	19.9806	19.9828	19.9760	19.9687	19.9636	19.9582	(88)
util rest of house	0.9987	0.9969	0.9913	0.9694	0.8941	0.7089	0.4961	0.5573	0.8475	0.9803	0.9970	0.9990	(89)
MIT 2	18.1453	18.3638	18.7282	19.2277	19.6595	19.9184	19.9727	19.9688	19.8146	19.2656	18.6283	18.1263	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.3137	18.5243	18.8759	19.3575	19.7759	20.0294	20.0850	20.0803	19.9262	19.3935	18.7788	18.2947	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3137	18.5243	18.8759	19.3575	19.7759	20.0294	20.0850	20.0803	19.9262	19.3935	18.7788	18.2947	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9952	0.9877	0.9621	0.8864	0.7136	0.5104	0.5708	0.8440	0.9746	0.9954	0.9984	(94)
Useful gains	670.2035	777.9439	872.4381	947.4120	932.7736	739.1915	505.0377	526.1461	714.5253	726.2681	659.5030	633.5521	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2142.9591	2076.9009	1880.7863	1566.2314	1206.2065	800.5275	513.8403	541.3293	863.3296	1313.3978	1754.0662	2129.1967	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1095.7302	872.8991	750.2111	445.5499	203.4341	0.0000	0.0000	0.0000	0.0000	436.8245	788.0855	1112.7596	(98)
Space heating												5705.4939	(98)
Space heating per m2											(98) / (4) =	43.5268	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6102.1325	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1095.7302	872.8991	750.2111	445.5499	203.4341	0.0000	0.0000	0.0000	0.0000	436.8245	788.0855	1112.7596	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1171.9039	933.5819	802.3648	476.5240	217.5765	0.0000	0.0000	0.0000	0.0000	467.1920	842.8722	1190.1172	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.4330	190.6782	200.0502	179.0489	175.2572	156.3045	149.8338	164.8001	164.6300	185.6772	196.6903	211.1302	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5418	88.3756	88.0155	87.1502	85.2122	79.8000	79.8000	79.8000	79.8000	87.0197	88.1395	88.6053	(217)
Fuel for water heating, kWh/month													
	244.4417	215.7590	227.2897	205.4486	205.6714	195.8703	187.7617	206.5164	206.3032	213.3738	223.1578	238.2817	(219)
Water heating fuel used												2569.8752	(219)
Annual totals kWh/year													
Space heating fuel - main system												6102.1325	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												9251.5406	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6102.1325	0.2160	1318.0606	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.8752	0.2160	555.0930	(264)
Space and water heating			1873.1537	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total CO2, kg/m2/year			2173.9312	(272)
Emissions per m2 for space and water heating			14.2902	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9977	(272b)
Emissions per m2 for pumps and fans			0.2970	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2902 * 1.00) + 1.9977 + 0.2970, rounded to 2 d.p.			16.5800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1180	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3685	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3685	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4699	0.4607	0.4515	0.4054	0.3962	0.3501	0.3501	0.3409	0.3685	0.3962	0.4146	0.4330	(22b)
Effective ac	0.6104	0.6061	0.6019	0.5822	0.5785	0.5613	0.5613	0.5581	0.5679	0.5785	0.5860	0.5938	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2539	67.7746	67.3047	65.0977	64.6847	62.7625	62.7625	62.4065	63.5029	64.6847	65.5201	66.3934	(38)
Heat transfer coeff	159.7032	159.2238	158.7539	156.5469	156.1340	154.2117	154.2117	153.8558	154.9522	156.1340	156.9693	157.8426	(39)
Average = Sum(39)m / 12 =												156.5449	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2184	1.2147	1.2111	1.1943	1.1911	1.1765	1.1765	1.1738	1.1821	1.1911	1.1975	1.2042	(40)
HLP (average)												1.1943	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977	(42)
Average daily hot water use (litres/day)	103.0212	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)
Total internal gains													
	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	612.9728	741.7759	864.1043	988.5736	1073.0832	1060.7366	1011.7462	929.5794	839.2738	714.6852	610.8988	573.2093	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6939	33.7954	33.8954	34.3733	34.4642	34.8938	34.8938	34.9745	34.7270	34.4642	34.2808	34.0911	
alpha	3.2463	3.2530	3.2597	3.2916	3.2976	3.3263	3.3263	3.3316	3.3151	3.2976	3.2854	3.2727	
util living area													
	0.9935	0.9874	0.9740	0.9401	0.8677	0.7404	0.5995	0.6557	0.8513	0.9615	0.9890	0.9948	(86)
MIT	18.8606	19.0947	19.4791	19.9906	20.4545	20.7881	20.9244	20.8966	20.6277	20.0193	19.3508	18.8280	(87)
Th 2	19.9053	19.9083	19.9111	19.9246	19.9271	19.9389	19.9389	19.9411	19.9343	19.9271	19.9220	19.9167	(88)
util rest of house													
	0.9920	0.9846	0.9679	0.9249	0.8310	0.6639	0.4810	0.5407	0.7960	0.9489	0.9861	0.9936	(89)
MIT 2	17.9467	18.1816	18.5647	19.0755	19.5158	19.8136	19.9092	19.8967	19.6866	19.1124	18.4478	17.9224	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.0487	18.2835	18.6667	19.1776	19.6205	19.9223	20.0224	20.0082	19.7916	19.2135	18.5486	18.0234	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0487	18.2835	18.6667	19.1776	19.6205	19.9223	20.0224	20.0082	19.7916	19.2135	18.5486	18.0234	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9885	0.9787	0.9585	0.9115	0.8185	0.6625	0.4912	0.5488	0.7869	0.9376	0.9808	0.9907	(94)
Useful gains	605.9203	725.9819	828.2420	901.0378	878.3385	702.7355	496.9465	510.1794	660.4422	670.1006	599.1413	567.8701	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2195.7035	2130.9671	1931.5112	1608.9261	1236.6654	820.7638	527.7739	555.1421	881.9224	1344.8629	1797.0722	2181.9277	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1182.7987	944.1501	820.8323	509.6795	266.5953	0.0000	0.0000	0.0000	0.0000	502.0231	862.5103	1200.8589	(98)
Space heating												6289.4482	(98)
Space heating per m2											(98) / (4) =	47.9818	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1449.5904	1141.1669	1169.3039	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7437	0.8162	0.7810	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1078.0156	931.3693	913.1928	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1359.7259	1299.8139	1206.3007	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	202.8314	274.1228	218.0723	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												695.0265	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	50.7079	68.5307	54.5181	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												173.7566	(107)
Space cooling per m2												1.3256	(108)
Energy for space heating												47.9818	(99)
Energy for space cooling												1.3256	(108)
Total												49.3073	(109)
Dwelling Fabric Energy Efficiency (DFEE)												49.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)
Total internal gains													
	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.6300	0.7000	0.7700	26.4823	(75)
Southwest	10.7600	36.7938	0.6300	0.7000	0.7700	120.9927	(79)

Solar gains	147.4750	260.0008	379.1091	508.8972	605.7533	617.0962	588.4032	513.7405	423.6768	293.6560	178.2429	125.1713	(83)
Total gains	589.5269	700.4404	803.8327	907.6680	976.7793	962.6293	918.2006	847.9039	771.9167	667.9991	582.5614	553.3093	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5268	59.7135	59.8976	60.7779	60.9455	61.7379	61.7379	61.8869	61.4302	60.9455	60.6074	60.2580	
alpha	4.9685	4.9809	4.9932	5.0519	5.0630	5.1159	5.1159	5.1258	5.0953	5.0630	5.0405	5.0172	
util living area													
	0.9995	0.9986	0.9959	0.9846	0.9434	0.8280	0.6667	0.7303	0.9286	0.9920	0.9988	0.9996	(86)
MIT	19.5967	19.7457	19.9964	20.3410	20.6644	20.8945	20.9737	20.9587	20.7802	20.3606	19.9203	19.5786	(87)
Th 2	19.9468	19.9497	19.9526	19.9662	19.9687	19.9806	19.9806	19.9828	19.9760	19.9687	19.9636	19.9582	(88)
util rest of house													
	0.9993	0.9981	0.9942	0.9778	0.9160	0.7464	0.5317	0.5998	0.8819	0.9875	0.9983	0.9995	(89)
MIT 2	18.6585	18.8096	19.0620	19.4139	19.7245	19.9268	19.9732	19.9695	19.8394	19.4378	18.9953	18.6495	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9974	0.9925	0.9739	0.9113	0.7515	0.5466	0.6136	0.8800	0.9848	0.9977	0.9993	(94)
Useful gains	588.9201	698.6159	797.8199	883.9420	890.1389	723.3883	501.8578	520.3121	679.3039	657.8365	581.2303	552.9008	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2211.6843	2136.3065	1924.9108	1590.1618	1214.1851	801.3087	513.8094	541.2617	866.0234	1335.3775	1802.0817	2198.4416	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1207.3366	966.1281	838.5556	508.4783	241.0904	0.0000	0.0000	0.0000	0.0000	504.0905	879.0130	1224.2823	(98)
Space heating												6368.9748	(98)
Space heating per m2											(98) / (4) =	48.5885	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1385.9584	1091.0737	1117.8641	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7886	0.8707	0.8341	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1092.9704	949.9688	932.4168	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1245.0551	1190.4749	1110.8358	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	109.5010	178.9365	132.7438	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												421.1813	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	27.3753	44.7341	33.1859	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												105.2953 (107)
Space cooling per m2												0.8033 (108)
Energy for space heating												48.5885 (99)
Energy for space cooling												0.8033 (108)
Total												49.3917 (109)
Target Fabric Energy Efficiency (TFEE)												56.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4180	0.3981	0.3981	0.3682	0.3682	0.3284	0.3384	0.3184	0.3284	0.3483	0.3483	0.3782	(22b)
Effective ac	0.5873	0.5792	0.5792	0.5678	0.5678	0.5539	0.5572	0.5507	0.5539	0.5607	0.5607	0.5715	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.6759	64.7678	64.7678	63.4888	63.4888	61.9385	62.3095	61.5786	61.9385	62.6915	62.6915	63.9041	(38)
Heat transfer coeff	157.1251	156.2171	156.2171	154.9381	154.9381	153.3877	153.7587	153.0279	153.3877	154.1408	154.1408	155.3533	(39)
Average = Sum(39)m / 12 =												154.7194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1987	1.1918	1.1918	1.1820	1.1820	1.1702	1.1730	1.1674	1.1702	1.1759	1.1759	1.1852	(40)
HLP (average)												1.1803	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
RHI water heating demand												2161	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	12.9236	0.4600	0.0000	0.7700	35.1554	(75)
Southwest	6.9600	40.4699	0.4600	0.0000	0.7700	99.7677	(79)
Southwest	3.8000	40.4699	0.4600	0.0000	0.7700	54.4709	(79)

Solar gains	189.3940	301.0775	435.5771	605.9916	705.4184	770.0630	725.9315	646.3477	528.8503	363.6009	234.6261	159.1331	(83)
Total gains	947.7682	1053.7175	1159.7585	1286.0768	1339.9184	1364.3980	1297.3396	1227.7988	1136.1947	1015.2767	935.3772	897.4308	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.2468	34.4458	34.4458	34.7302	34.7302	35.0812	34.9966	35.1637	35.0812	34.9098	34.9098	34.6374	
alpha	3.2831	3.2964	3.2964	3.3153	3.3153	3.3387	3.3331	3.3442	3.3387	3.3273	3.3273	3.3092	
util living area													
	0.9738	0.9619	0.9333	0.8654	0.7375	0.5229	0.3590	0.3875	0.6682	0.8833	0.9561	0.9774	(86)
MIT	19.3539	19.5426	19.9090	20.3630	20.7362	20.9437	20.9886	20.9854	20.8627	20.4195	19.8336	19.3294	(87)
Th 2	19.9210	19.9266	19.9266	19.9344	19.9344	19.9439	19.9416	19.9461	19.9439	19.9393	19.9393	19.9319	(88)
util rest of house													
	0.9683	0.9540	0.9188	0.8352	0.6775	0.4266	0.2403	0.2651	0.5796	0.8502	0.9453	0.9726	(89)
MIT 2	17.7615	18.0363	18.5600	19.1956	19.6783	19.9085	19.9384	19.9416	19.8374	19.2891	18.4671	17.7333	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	17.9391	18.2043	18.7104	19.3258	19.7963	20.0240	20.0555	20.0580	19.9517	19.4152	18.6195	17.9113	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7891	18.0543	18.5604	19.1758	19.6463	19.8740	19.9055	19.9080	19.8017	19.2652	18.4695	17.7613	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9346	0.8943	0.8090	0.6591	0.4198	0.2362	0.2605	0.5663	0.8234	0.9244	0.9581	(94)
Useful gains	902.6299	984.7897	1037.2092	1040.4048	883.0970	572.7291	306.4085	319.8561	643.3760	836.0271	864.6479	859.7892	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1993.7775	1945.5775	1743.4516	1437.1714	1029.7594	594.2216	308.3685	322.5870	705.8486	1181.5141	1613.7801	1966.9765	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	811.8138	645.6494	525.4444	285.6719	109.1168	0.0000	0.0000	0.0000	0.0000	257.0423	539.3752	823.7474	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3997.8611 (98)
RHI space heating demand	3998 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4379	0.4279	0.3782	0.3782	0.3682	0.3981	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5916	0.5715	0.5715	0.5678	0.5792	0.5916	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.3102	69.7510	69.2028	66.6282	66.1465	63.9041	63.9041	63.4888	64.7678	66.1465	67.1210	68.1398	(38)
Heat transfer coeff	161.7594	161.2002	160.6521	158.0774	157.5957	155.3533	155.3533	154.9381	156.2171	157.5957	158.5702	159.5890	(39)
Average = Sum(39)m / 12 =												158.0751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2298	1.2256	1.2060	1.2023	1.1852	1.1852	1.1820	1.1918	1.2023	1.2097	1.2175	(40)
HLP (average)												1.2059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	929.2951	1053.9762	1163.5620	1269.8881	1336.5572	1309.5385	1253.3569	1176.8671	1098.3782	992.0178	907.3315	883.3690	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2656	33.3810	33.4949	34.0405	34.1445	34.6374	34.6374	34.7302	34.4458	34.1445	33.9347	33.7180	
alpha	3.2177	3.2254	3.2330	3.2694	3.2763	3.3092	3.3092	3.3153	3.2964	3.2763	3.2623	3.2479	
util living area													
	0.9786	0.9668	0.9440	0.8934	0.8002	0.6535	0.5094	0.5544	0.7600	0.9137	0.9667	0.9816	(86)
MIT	19.1449	19.3663	19.7227	20.1883	20.5864	20.8548	20.9527	20.9368	20.7454	20.2352	19.6174	19.1139	(87)
Th 2	19.8929	19.8962	19.8996	19.9152	19.9182	19.9319	19.9319	19.9344	19.9266	19.9182	19.9122	19.9060	(88)
util rest of house													
	0.9742	0.9600	0.9321	0.8697	0.7540	0.5732	0.3997	0.4449	0.6907	0.8896	0.9588	0.9778	(89)
MIT 2	17.4411	17.7627	18.2764	18.9424	19.4787	19.8126	19.9063	19.8974	19.6943	19.0222	18.1394	17.4044	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6311	17.9415	18.4377	19.0814	19.6022	19.9288	20.0230	20.0134	19.8115	19.1575	18.3043	17.5950	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4811	17.7915	18.2877	18.9314	19.4522	19.7788	19.8730	19.8634	19.6615	19.0075	18.1543	17.4450	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9598	0.9415	0.9085	0.8427	0.7306	0.5605	0.3933	0.4370	0.6708	0.8629	0.9401	0.9649	(94)
Useful gains	891.9438	992.3265	1057.1165	1070.1546	976.5474	734.0171	492.8872	514.2479	736.7458	855.9693	852.9771	852.3754	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2132.1739	2078.1189	1893.7264	1585.7369	1221.7154	804.5505	508.4728	536.6051	868.8043	1324.9832	1752.8778	2113.7611	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	922.7312	729.6525	622.4378	371.2193	182.4050	0.0000	0.0000	0.0000	0.0000	348.9463	647.9285	938.4709	(98)
Space heating												4763.7916	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2 (98) / (4) = 36.3426 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5269.6809	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	922.7312	729.6525	622.4378	371.2193	182.4050	0.0000	0.0000	0.0000	0.0000	348.9463	647.9285	938.4709	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1020.7204	807.1377	688.5374	410.6408	201.7754	0.0000	0.0000	0.0000	0.0000	386.0026	716.7351	1038.1316	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1722	87.9761	87.5679	86.6497	84.8587	79.7000	79.7000	79.7000	79.7000	86.4069	87.6847	88.2454	(217)
Fuel for water heating, kWh/month	242.6124	214.1552	225.5780	203.8250	203.5629	193.0607	184.8401	203.6183	203.5067	211.9748	221.5382	236.4020	(219)
Water heating fuel used												2544.6743	(219)
Annual totals kWh/year													
Space heating fuel - main system												5269.6809	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												8393.8881	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5269.6809	3.4800	183.3849	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2544.6743	3.4800	88.5547	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Total energy cost			468.3800	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1172	(257)
SAP value		84.4148	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5269.6809	0.2160	1138.2511	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2544.6743	0.2160	549.6496	(264)
Space and water heating			1687.9007	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total kg/year			1988.6783	(272)
CO2 emissions per m2			15.1700	(273)
EI value			84.8658	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8470 = 4.109, stars = 4

Water heating environmental impact 0.216 / 0.8470 = 0.2550, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400	(1b)	x 2.5400	(2b) =	166.4716	(1b) - (3b)
First floor	65.5400	(1c)	x 2.6300	(2c) =	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3981	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4180	0.3981	0.3981	0.3682	0.3682	0.3284	0.3384	0.3184	0.3284	0.3483	0.3483	0.3782	(22b)
Effective ac	0.5873	0.5792	0.5792	0.5678	0.5678	0.5539	0.5572	0.5507	0.5539	0.5607	0.5607	0.5715	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.6759	64.7678	64.7678	63.4888	63.4888	61.9385	62.3095	61.5786	61.9385	62.6915	62.6915	63.9041	(38)
Heat transfer coeff	157.1251	156.2171	156.2171	154.9381	154.9381	153.3877	153.7587	153.0279	153.3877	154.1408	154.1408	155.3533	(39)
Average = Sum(39)m / 12 =												154.7194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1987	1.1918	1.1918	1.1820	1.1820	1.1702	1.1730	1.1674	1.1702	1.1759	1.1759	1.1852	(40)
HLP (average)												1.1803	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	12.9236	0.4600	0.0000	0.7700	35.1554	(75)
Southwest	6.9600	40.4699	0.4600	0.0000	0.7700	99.7677	(79)
Southwest	3.8000	40.4699	0.4600	0.0000	0.7700	54.4709	(79)

Solar gains	189.3940	301.0775	435.5771	605.9916	705.4184	770.0630	725.9315	646.3477	528.8503	363.6009	234.6261	159.1331	(83)
Total gains	947.7682	1053.7175	1159.7585	1286.0768	1339.9184	1364.3980	1297.3396	1227.7988	1136.1947	1015.2767	935.3772	897.4308	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.2468	34.4458	34.4458	34.7302	34.7302	35.0812	34.9966	35.1637	35.0812	34.9098	34.9098	34.6374	
alpha	3.2831	3.2964	3.2964	3.3153	3.3153	3.3387	3.3331	3.3442	3.3387	3.3273	3.3273	3.3092	
util living area													
	0.9738	0.9619	0.9333	0.8654	0.7375	0.5229	0.3590	0.3875	0.6682	0.8833	0.9561	0.9774	(86)
MIT	19.3539	19.5426	19.9090	20.3630	20.7362	20.9437	20.9886	20.9854	20.8627	20.4195	19.8336	19.3294	(87)
Th 2	19.9210	19.9266	19.9266	19.9344	19.9344	19.9439	19.9416	19.9461	19.9439	19.9393	19.9393	19.9319	(88)
util rest of house													
	0.9683	0.9540	0.9188	0.8352	0.6775	0.4266	0.2403	0.2651	0.5796	0.8502	0.9453	0.9726	(89)
MIT 2	17.7615	18.0363	18.5600	19.1956	19.6783	19.9085	19.9384	19.9416	19.8374	19.2891	18.4671	17.7333	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9391	18.2043	18.7104	19.3258	19.7963	20.0240	20.0555	20.0580	19.9517	19.4152	18.6195	17.9113	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7891	18.0543	18.5604	19.1758	19.6463	19.8740	19.9055	19.9080	19.8017	19.2652	18.4695	17.7613	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9346	0.8943	0.8090	0.6591	0.4198	0.2362	0.2605	0.5663	0.8234	0.9244	0.9581	(94)
Useful gains	902.6299	984.7897	1037.2092	1040.4048	883.0970	572.7291	306.4085	319.8561	643.3760	836.0271	864.6479	859.7892	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1993.7775	1945.5775	1743.4516	1437.1714	1029.7594	594.2216	308.3685	322.5870	705.8486	1181.5141	1613.7801	1966.9765	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	811.8138	645.6494	525.4444	285.6719	109.1168	0.0000	0.0000	0.0000	0.0000	257.0423	539.3752	823.7474	(98)
Space heating												3997.8611	(98)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating per m2 (98) / (4) = 30.4994 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4422.4127 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	811.8138	645.6494	525.4444	285.6719	109.1168	0.0000	0.0000	0.0000	0.0000	257.0423	539.3752	823.7474	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	898.0241	714.2140	581.2438	316.0088	120.7044	0.0000	0.0000	0.0000	0.0000	284.3388	596.6539	911.2250	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.9379	87.7392	87.2014	85.9895	83.5274	79.7000	79.7000	79.7000	79.7000	85.6174	87.2967	88.0123	(217)
Fuel for water heating, kWh/month	243.2589	214.7335	226.5261	205.3898	206.8074	193.0607	184.8401	203.6183	203.5067	213.9296	222.5228	237.0282	(219)
Water heating fuel used												2555.2221	(219)

Annual totals kWh/year	
Space heating fuel - main system	4422.4127 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	75.0000 (231)
Electricity for lighting (calculated in Appendix L)	504.5329 (232)
Total delivered energy for all uses	7557.1677 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4422.4127	3.9200	173.3586	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2555.2221	3.9200	100.1647	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	504.5329	16.9600	85.5688	(250)
Additional standing charges			88.0000	(251)
Total energy cost			459.8121	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4422.4127	0.2160	955.2411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2555.2221	0.2160	551.9280	(264)
Space and water heating			1507.1691	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total kg/year			1807.9467	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4422.4127	1.2200	5395.3435	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2555.2221	1.2200	3117.3709	(264)
Space and water heating			8512.7144	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	504.5329	3.0700	1548.9160	(268)
Primary energy kWh/year			10291.8804	(272)
Primary energy kWh/m2/year			78.5160	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 44	-261 kg (14.4%)
U Solar photovoltaic panels	+ 7.6	-£ 309	-947 kg (61.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.99 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	7.22 kg/m²	A 93	A 94
Total Savings	£353	9.21 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£98	£107	-£8
Mains gas	£362	£309	£52
Space heating	£274	£275	-£1
Water heating	£100	£55	£45
Lighting	£86	£86	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£460	£107	£353
Total cost of uses	£460	£107	£353
Delivered energy	58 kWh/m²	34 kWh/m²	24 kWh/m²
Carbon dioxide emissions	1.8 tonnes	0.6 tonnes	1.2 tonnes
CO2 emissions per m²	14 kg/m²	5 kg/m²	9 kg/m²
Primary energy	79 kWh/m²	25 kWh/m²	54 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400	(1b)	x 2.5400	(2b) =	166.4716	(1b) - (3b)
First floor	65.5400	(1c)	x 2.6300	(2c) =	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4379	0.4279	0.3782	0.3782	0.3682	0.3981	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5916	0.5715	0.5715	0.5678	0.5792	0.5916	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.3102	69.7510	69.2028	66.6282	66.1465	63.9041	63.9041	63.4888	64.7678	66.1465	67.1210	68.1398	(38)
Heat transfer coeff	161.7594	161.2002	160.6521	158.0774	157.5957	155.3533	155.3533	154.9381	156.2171	157.5957	158.5702	159.5890	(39)
Average = Sum(39)m / 12 =												158.0751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2298	1.2256	1.2060	1.2023	1.1852	1.1852	1.1820	1.1918	1.2023	1.2097	1.2175	(40)
HLP (average)												1.2059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1189	(H8)
Utilisation factor												0.5909	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-942.2780	(H17)
Solar input	-27.3242	-45.5962	-77.6556	-104.0738	-128.5744	-126.4091	-124.7385	-108.9847	-85.3569	-58.2887	-32.4104	-22.8657	(63)
										Solar input (sum of months) = Sum(63)m =		-942.2780	(63)
Output from w/h													
	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
										Total per year (kWh/year) = Sum(64)m =		1060.5180	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	920.8350	1045.5162	1153.6012	1253.9240	1314.3398	1287.0710	1230.8894	1155.4001	1083.9149	982.0569	898.8714	874.9089	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2656	33.3810	33.4949	34.0405	34.1445	34.6374	34.6374	34.7302	34.4458	34.1445	33.9347	33.7180	
alpha	3.2177	3.2254	3.2330	3.2694	3.2763	3.3092	3.3092	3.3153	3.2964	3.2763	3.2623	3.2479	
util living area													
	0.9791	0.9675	0.9452	0.8963	0.8060	0.6611	0.5170	0.5625	0.7651	0.9157	0.9675	0.9821	(86)
MIT	19.1368	19.3586	19.7144	20.1773	20.5759	20.8496	20.9506	20.9340	20.7398	20.2278	19.6096	19.1057	(87)
Th 2	19.8929	19.8962	19.8996	19.9152	19.9182	19.9319	19.9319	19.9344	19.9266	19.9182	19.9122	19.9060	(88)
util rest of house													
	0.9748	0.9609	0.9335	0.8731	0.7605	0.5808	0.4063	0.4521	0.6964	0.8920	0.9598	0.9784	(89)
MIT 2	17.4295	17.7517	18.2648	18.9277	19.4662	19.8078	19.9050	19.8956	19.6883	19.0122	18.1284	17.3925	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	17.6199	17.9309	18.4264	19.0671	19.5899	19.9240	20.0216	20.0114	19.8056	19.1478	18.2936	17.5836	(92)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.4699	17.7809	18.2764	18.9171	19.4399	19.7740	19.8716	19.8614	19.6556	18.9978	18.1436	17.4336	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9607	0.9425	0.9101	0.8461	0.7368	0.5677	0.3996	0.4439	0.6760	0.8653	0.9413	0.9657	(94)
Useful gains	884.6071	985.4371	1049.8736	1060.9845	968.3887	730.6184	491.9162	512.8925	732.7467	849.8211	846.1289	844.9141	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2130.3587	2076.4017	1891.9099	1583.4748	1219.7825	803.7999	508.2593	536.3074	867.8788	1323.4607	1751.1886	2111.9386	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	926.8392	733.1282	626.4750	376.1930	187.0370	0.0000	0.0000	0.0000	0.0000	352.3878	651.6430	942.6662	(98)
Space heating												4796.3694	(98)
Space heating per m2											(98) / (4) =	36.5912	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5305.7184	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	926.8392	733.1282	626.4750	376.1930	187.0370	0.0000	0.0000	0.0000	0.0000	352.3878	651.6430	942.6662	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1025.2646	810.9825	693.0033	416.1427	206.8994	0.0000	0.0000	0.0000	0.0000	389.8095	720.8440	1042.7724	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4797	88.5433	88.6146	88.8033	89.0651	79.7000	79.7000	79.7000	79.7000	87.4982	88.1355	88.5136	(217)
Fuel for water heating, kWh/month	201.9951	153.2614	124.8267	65.5069	26.3901	9.0834	2.1132	41.8254	80.0766	132.1269	174.9928	200.9639	(219)
Water heating fuel used												1213.1623	(219)
Annual totals kWh/year													
Space heating fuel - main system												5305.7184	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												5421.1742	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5305.7184	3.4800	184.6390	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1213.1623	3.4800	42.2180	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			202.0696	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4820	(257)
SAP value		93.2762	
SAP rating (Section 12)		93	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5305.7184	0.2160	1146.0352	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1213.1623	0.2160	262.0431	(264)
Space and water heating			1408.0782	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			838.3686	(272)
CO2 emissions per m2			6.4000	(273)
EI value			93.6199	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3981	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4180	0.3981	0.3981	0.3682	0.3682	0.3284	0.3384	0.3184	0.3284	0.3483	0.3483	0.3782	(22b)
Effective ac	0.5873	0.5792	0.5792	0.5678	0.5678	0.5539	0.5572	0.5507	0.5539	0.5607	0.5607	0.5715	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			70.0500			39.0000	2731.9500	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19371.7010	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.7853	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.6759	64.7678	64.7678	63.4888	63.4888	61.9385	62.3095	61.5786	61.9385	62.6915	62.6915	63.9041	(38)
Heat transfer coeff	157.1251	156.2171	156.2171	154.9381	154.9381	153.3877	153.7587	153.0279	153.3877	154.1408	154.1408	155.3533	(39)
Average = Sum(39)m / 12 =												154.7194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1987	1.1918	1.1918	1.1820	1.1820	1.1702	1.1730	1.1674	1.1702	1.1759	1.1759	1.1852	(40)
HLP (average)												1.1803	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1817	(H8)
Utilisation factor												0.5710	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-961.6433	(H17)
Solar input	-29.5989	-44.4871	-74.9219	-103.5650	-124.7271	-131.2698	-128.1178	-114.4099	-89.2974	-60.7473	-35.9782	-24.5229	(63)
										Solar input (sum of months) = Sum(63)m =		-961.6433	(63)
Output from w/h													
	176.4499	136.8119	113.3484	58.6811	27.3517	2.3788	0.0000	27.9095	59.8805	113.1500	150.6629	176.2232	(64)
										Total per year (kWh/year) = Sum(64)m =		1042.8478	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	12.9236	0.4600	0.0000	0.7700	35.1554	(75)
Southwest	6.9600	40.4699	0.4600	0.0000	0.7700	99.7677	(79)
Southwest	3.8000	40.4699	0.4600	0.0000	0.7700	54.4709	(79)

Solar gains	189.3940	301.0775	435.5771	605.9916	705.4184	770.0630	725.9315	646.3477	528.8503	363.6009	234.6261	159.1331	(83)
Total gains	939.3082	1045.2574	1149.7977	1270.1128	1317.7010	1341.9305	1274.8721	1206.3318	1121.7314	1005.3158	926.9172	888.9708	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.2468	34.4458	34.4458	34.7302	34.7302	35.0812	34.9966	35.1637	35.0812	34.9098	34.9098	34.6374	
alpha	3.2831	3.2964	3.2964	3.3153	3.3153	3.3387	3.3331	3.3442	3.3387	3.3273	3.3273	3.3092	
util living area													
	0.9745	0.9627	0.9347	0.8688	0.7442	0.5300	0.3649	0.3939	0.6738	0.8858	0.9571	0.9780	(86)
MIT	19.3459	19.5349	19.9009	20.3531	20.7283	20.9414	20.9880	20.9847	20.8591	20.4129	19.8261	19.3213	(87)
Th 2	19.9210	19.9266	19.9266	19.9344	19.9344	19.9439	19.9416	19.9461	19.9439	19.9393	19.9393	19.9319	(88)
util rest of house													
	0.9691	0.9550	0.9204	0.8391	0.6847	0.4329	0.2445	0.2697	0.5853	0.8531	0.9466	0.9733	(89)
MIT 2	17.7501	18.0255	18.5488	19.1828	19.6697	19.9069	19.9382	19.9414	19.8342	19.2806	18.4566	17.7216	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9280	18.1938	18.6996	19.3133	19.7878	20.0223	20.0553	20.0577	19.9485	19.4069	18.6093	17.9000	(92)

Temperature adjustment												-0.1500	
adjusted MIT	17.7780	18.0438	18.5496	19.1633	19.6378	19.8723	19.9053	19.9077	19.7985	19.2569	18.4593	17.7500	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9357	0.8961	0.8128	0.6658	0.4259	0.2402	0.2650	0.5716	0.8264	0.9258	0.9590	(94)
Useful gains	895.4921	978.0819	1030.3452	1032.3844	877.3168	571.5283	306.2691	319.6637	641.1469	830.7492	858.1812	852.5146	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1992.0388	1943.9378	1741.7628	1435.2405	1028.4454	593.9635	308.3346	322.5412	705.3560	1180.2384	1612.2087	1965.2243	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	815.8308	649.0552	529.2947	290.0564	112.4397	0.0000	0.0000	0.0000	0.0000	260.0200	542.8998	827.8560	(98)
Space heating												4027.4526	(98)
Space heating per m2											(98) / (4) =	30.7251	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4455.1467	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	815.8308	649.0552	529.2947	290.0564	112.4397	0.0000	0.0000	0.0000	0.0000	260.0200	542.8998	827.8560	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	902.4677	717.9814	585.5030	320.8589	124.3802	0.0000	0.0000	0.0000	0.0000	287.6328	600.5528	915.7699	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	176.4499	136.8119	113.3484	58.6811	27.3517	2.3788	0.0000	27.9095	59.8805	113.1500	150.6629	176.2232	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.2922	88.3354	88.3089	88.4029	88.0861	79.7000	79.7000	79.7000	79.7000	86.8640	87.8383	88.3190	(217)
Fuel for water heating, kWh/month	199.8477	154.8777	128.3544	66.3791	31.0510	2.9846	0.0000	35.0182	75.1324	130.2611	171.5230	199.5304	(219)
Water heating fuel used												1194.9598	(219)
Annual totals kWh/year													
Space heating fuel - main system												4455.1467	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												4455.4797	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4455.1467	3.9200	174.6417	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1194.9598	3.9200	46.8424	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	504.5329	16.9600	85.5688	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			106.8755	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4455.1467	0.2160	962.3117	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1194.9598	0.2160	258.1113	(264)
Space and water heating			1220.4230	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	504.5329	0.5190	261.8526 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			600.4117 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4455.1467	1.2200	5435.2789 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1194.9598	1.2200	1457.8509 (264)
Space and water heating			6893.1299 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	504.5329	3.0700	1548.9160 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			3225.6258 (272)
Primary energy kWh/m2/year			24.6081 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	447.27 (P1)
Transmission heat loss coefficient	91.45 (37)
Summer heat loss coefficient	538.72 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.6800	98.8453	0.4600	0.0000	0.9000	314.2805
South West	6.9600	119.9223	0.4600	0.0000	0.9000	345.5490
South West	3.8000	119.9223	0.4600	0.0000	0.9000	188.6618
total:						848.4914

	Jun	Jul	Aug	
Solar gains	900	848	755	(P4)
Internal gains	591	568	578	
Total summer gains	1491	1417	1334	(P5)
Summer gain/loss ratio	2.77	2.63	2.48	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.8)	0.97	0.97	0.97	
Threshold temperature	19.73	21.50	21.24	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-328	**Issued on Date**	19/10/2022
Assessment Reference	Plot 328	**Prop Type Ref**	Richmond-As-DET
Property	Plot 328, 4 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	16.50	**TER**	16.58
Environmental	85 B	**% DER<TER**	0.51		
CO_2 Emissions (t/year)	1.81	**DFEE**	49.34	**TFEE**	56.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.14		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 131 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.50 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.3 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.68 m², No overhang
Windows facing South West: 10.76 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.026 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4379	0.4279	0.3782	0.3782	0.3682	0.3981	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5916	0.5715	0.5715	0.5678	0.5792	0.5916	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.3102	69.7510	69.2028	66.6282	66.1465	63.9041	63.9041	63.4888	64.7678	66.1465	67.1210	68.1398	(38)
Heat transfer coeff	161.7594	161.2002	160.6521	158.0774	157.5957	155.3533	155.3533	154.9381	156.2171	157.5957	158.5702	159.5890	(39)
Average = Sum(39)m / 12 =												158.0751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2298	1.2256	1.2060	1.2023	1.1852	1.1852	1.1820	1.1918	1.2023	1.2097	1.2175	(40)
HLP (average)												1.2059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	521.4710	518.9998	501.5003	473.1227	443.8038	416.0943	398.4746	405.2546	420.1887	448.8016	481.6107	506.7017	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	692.3918	820.3361	940.8809	1062.9255	1145.8610	1131.2978	1080.4234	1000.6706	911.2226	789.1436	688.1910	651.7730	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5971	33.7137	33.8287	34.3797	34.4848	34.9825	34.9825	35.0763	34.7891	34.4848	34.2728	34.0541	
alpha	3.2398	3.2476	3.2552	3.2920	3.2990	3.3322	3.3322	3.3384	3.3193	3.2990	3.2849	3.2703	
util living area													
	0.9909	0.9836	0.9682	0.9302	0.8516	0.7173	0.5741	0.6266	0.8284	0.9514	0.9849	0.9926	(86)
MIT	18.9277	19.1589	19.5381	20.0428	20.4921	20.8096	20.9340	20.9106	20.6641	20.0790	19.4204	18.8991	(87)
Th 2	19.8929	19.8962	19.8996	19.9152	19.9182	19.9319	19.9319	19.9344	19.9266	19.9182	19.9122	19.9060	(88)
util rest of house													
	0.9889	0.9800	0.9608	0.9128	0.8120	0.6385	0.4567	0.5115	0.7681	0.9359	0.9809	0.9909	(89)
MIT 2	17.1253	17.4635	18.0147	18.7454	19.3643	19.7702	19.8949	19.8798	19.6062	18.8096	17.8560	17.0915	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.3263	17.6526	18.1846	18.8901	19.4901	19.8861	20.0108	19.9948	19.7242	18.9512	18.0305	17.2931	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1763	17.5026	18.0346	18.7401	19.3401	19.7361	19.8608	19.8448	19.5742	18.8012	17.8805	17.1431	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9810	0.9680	0.9426	0.8877	0.7860	0.6220	0.4481	0.5007	0.7435	0.9131	0.9693	0.9841	(94)
Useful gains	679.2300	794.0515	886.8666	943.5329	900.6665	703.6801	484.1729	501.0425	677.5070	720.5627	667.0624	641.4363	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2082.8637	2031.5412	1853.0650	1555.4958	1204.0412	797.9146	506.5796	533.7309	855.1682	1292.4746	1709.4627	2065.5762	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1044.3034	831.5931	718.8516	440.6133	225.7108	0.0000	0.0000	0.0000	0.0000	425.5024	750.5282	1059.5601	(98)
Space heating												5496.6629	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 41.9337 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6080.3794	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1044.3034	831.5931	718.8516	440.6133	225.7108	0.0000	0.0000	0.0000	0.0000	425.5024	750.5282	1059.5601	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1155.2029	919.9039	795.1898	487.4041	249.6801	0.0000	0.0000	0.0000	0.0000	470.6885	830.2303	1172.0797	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3827	88.2125	87.8575	87.0557	85.4278	79.7000	79.7000	79.7000	79.7000	86.8897	87.9717	88.4467	(217)
Fuel for water heating, kWh/month													
	242.0347	213.5813	224.8345	202.8743	202.2068	193.0607	184.8401	203.6183	203.5067	210.7971	220.8156	235.8640	(219)
Water heating fuel used												2538.0340	(219)
Annual totals kWh/year													
Space heating fuel - main system												6080.3794	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												9197.9463	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6080.3794	0.2160	1313.3619	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2538.0340	0.2160	548.2154	(264)
Space and water heating			1861.5773	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total CO2, kg/year			2162.3549	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.5000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.5000	ZC1
Total Floor Area	TFA	131.0800	
Assumed number of occupants	N	2.8977	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5178	ZC2
CO2 emissions from cooking, equation (L16)		1.4384	ZC3
Total CO2 emissions		31.4562	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.4562	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)

Water storage loss:	
Store volume	170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5003 (48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.8102 (55)
Total storage loss
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (56)
If cylinder contains dedicated solar storage
              25.1153    22.6848    25.1153    24.3051    25.1153    24.3051    25.1153    25.1153    24.3051    25.1153    24.3051    25.1153 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              216.4330   190.6782   200.0502   179.0489   175.2572   156.3045   149.8338   164.8001   164.6300   185.6772   196.6903   211.1302 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2190.5335 (64)
Heat gains from water heating, kWh/month
               94.5805    83.8284    89.1333    81.4208    80.8896    73.8582    72.4363    77.4126    76.6265    84.3542    87.2865    92.8174 (65)
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)

Water heating gains (Table 5)

	127.1244	124.7446	119.8028	113.0844	108.7226	102.5809	97.3607	104.0492	106.4257	113.3794	121.2313	124.7545	(72)

Total internal gains

	524.1767	521.7055	504.2060	475.8284	446.5095	418.8000	401.1803	407.9603	422.8944	451.5073	484.3164	509.4074	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.6300	0.7000	0.7700	26.4823	(75)
Southwest	10.7600	36.7938	0.6300	0.7000	0.7700	120.9927	(79)

Solar gains	147.4750	260.0008	379.1091	508.8972	605.7533	617.0962	588.4032	513.7405	423.6768	293.6560	178.2429	125.1713	(83)
Total gains	671.6517	781.7063	883.3151	984.7257	1052.2628	1035.8962	989.5836	921.7007	846.5712	745.1633	662.5593	634.5787	(84)

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5268	59.7135	59.8976	60.7779	60.9455	61.7379	61.7379	61.8869	61.4302	60.9455	60.6074	60.2580	
alpha	4.9685	4.9809	4.9932	5.0519	5.0630	5.1159	5.1159	5.1258	5.0953	5.0630	5.0405	5.0172	
util living area	0.9990	0.9977	0.9937	0.9785	0.9270	0.7951	0.6274	0.6870	0.9038	0.9872	0.9979	0.9993	(86)
MIT	19.6551	19.8032	20.0517	20.3911	20.7031	20.9137	20.9799	20.9687	20.8150	20.4130	19.9772	19.6366	(87)
Th 2	19.9468	19.9497	19.9526	19.9662	19.9687	19.9806	19.9806	19.9828	19.9760	19.9687	19.9636	19.9582	(88)
util rest of house	0.9987	0.9969	0.9913	0.9694	0.8941	0.7089	0.4961	0.5573	0.8475	0.9803	0.9970	0.9990	(89)
MIT 2	18.1453	18.3638	18.7282	19.2277	19.6595	19.9184	19.9727	19.9688	19.8146	19.2656	18.6283	18.1263	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	18.3137	18.5243	18.8759	19.3575	19.7759	20.0294	20.0850	20.0803	19.9262	19.3935	18.7788	18.2947	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3137	18.5243	18.8759	19.3575	19.7759	20.0294	20.0850	20.0803	19.9262	19.3935	18.7788	18.2947	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9952	0.9877	0.9621	0.8864	0.7136	0.5104	0.5708	0.8440	0.9746	0.9954	0.9984	(94)
Useful gains	670.2035	777.9439	872.4381	947.4120	932.7736	739.1915	505.0377	526.1461	714.5253	726.2681	659.5030	633.5521	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2142.9591	2076.9009	1880.7863	1566.2314	1206.2065	800.5275	513.8403	541.3293	863.3296	1313.3978	1754.0662	2129.1967	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1095.7302	872.8991	750.2111	445.5499	203.4341	0.0000	0.0000	0.0000	0.0000	436.8245	788.0855	1112.7596	(98)
Space heating												5705.4939	(98)
Space heating per m2											(98) / (4) =	43.5268	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6102.1325	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1095.7302	872.8991	750.2111	445.5499	203.4341	0.0000	0.0000	0.0000	0.0000	436.8245	788.0855	1112.7596	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1171.9039	933.5819	802.3648	476.5240	217.5765	0.0000	0.0000	0.0000	0.0000	467.1920	842.8722	1190.1172	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.4330	190.6782	200.0502	179.0489	175.2572	156.3045	149.8338	164.8001	164.6300	185.6772	196.6903	211.1302	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5418	88.3756	88.0155	87.1502	85.2122	79.8000	79.8000	79.8000	79.8000	87.0197	88.1395	88.6053	(217)
Fuel for water heating, kWh/month													
	244.4417	215.7590	227.2897	205.4486	205.6714	195.8703	187.7617	206.5164	206.3032	213.3738	223.1578	238.2817	(219)
Water heating fuel used												2569.8752	(219)
Annual totals kWh/year													
Space heating fuel - main system												6102.1325	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Total delivered energy for all uses												9251.5406	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6102.1325	0.2160	1318.0606	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.8752	0.2160	555.0930	(264)
Space and water heating			1873.1537	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total CO2, kg/m2/year			2173.9312	(272)
Emissions per m2 for space and water heating			14.2902	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9977	(272b)
Emissions per m2 for pumps and fans			0.2970	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2902 * 1.00) + 1.9977 + 0.2970, rounded to 2 d.p.			16.5800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3685	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3685	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4699	0.4607	0.4515	0.4054	0.3962	0.3501	0.3501	0.3409	0.3685	0.3962	0.4146	0.4330	(22b)
Effective ac	0.6104	0.6061	0.6019	0.5822	0.5785	0.5613	0.5613	0.5581	0.5679	0.5785	0.5860	0.5938	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2539	67.7746	67.3047	65.0977	64.6847	62.7625	62.7625	62.4065	63.5029	64.6847	65.5201	66.3934	(38)
Heat transfer coeff	159.7032	159.2238	158.7539	156.5469	156.1340	154.2117	154.2117	153.8558	154.9522	156.1340	156.9693	157.8426	(39)
Average = Sum(39)m / 12 =												156.5449	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2184	1.2147	1.2111	1.1943	1.1911	1.1765	1.1765	1.1738	1.1821	1.1911	1.1975	1.2042	(40)
HLP (average)												1.1943	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)
Total internal gains													
	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	612.9728	741.7759	864.1043	988.5736	1073.0832	1060.7366	1011.7462	929.5794	839.2738	714.6852	610.8988	573.2093	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0297	34.1322	34.2332	34.7158	34.8076	35.2415	35.2415	35.3230	35.0731	34.8076	34.6224	34.4308	
alpha	3.2686	3.2755	3.2822	3.3144	3.3205	3.3494	3.3494	3.3549	3.3382	3.3205	3.3082	3.2954	
util living area													
	0.9937	0.9877	0.9746	0.9410	0.8689	0.7416	0.6003	0.6566	0.8526	0.9622	0.9893	0.9950	(86)
MIT	18.8751	19.1077	19.4898	19.9984	20.4596	20.7908	20.9257	20.8983	20.6314	20.0265	19.3622	18.8428	(87)
Th 2	19.9053	19.9083	19.9111	19.9246	19.9271	19.9389	19.9389	19.9411	19.9343	19.9271	19.9220	19.9167	(88)
util rest of house													
	0.9923	0.9850	0.9685	0.9259	0.8323	0.6648	0.4814	0.5413	0.7972	0.9498	0.9864	0.9938	(89)
MIT 2	17.9600	18.1935	18.5744	19.0823	19.5201	19.8156	19.9099	19.8976	19.6894	19.1185	18.4580	17.9360	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	18.0621	18.2955	18.6765	19.1845	19.6249	19.9243	20.0232	20.0092	19.7945	19.2198	18.5589	18.0371	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0621	18.2955	18.6765	19.1845	19.6249	19.9243	20.0232	20.0092	19.7945	19.2198	18.5589	18.0371	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9889	0.9793	0.9594	0.9127	0.8200	0.6636	0.4918	0.5496	0.7884	0.9387	0.9813	0.9910	(94)
Useful gains	606.1391	726.3944	828.9807	902.2759	879.9132	703.9533	497.5304	510.8888	661.6554	670.8653	599.4587	568.0449	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2197.8490	2132.8838	1933.0616	1610.0088	1237.3386	821.0769	527.8911	555.2937	882.3691	1345.8412	1798.6912	2184.0886	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1184.2322	945.1609	821.4362	509.5677	265.9245	0.0000	0.0000	0.0000	0.0000	502.1821	863.4474	1202.3365	(98)
Space heating												6294.2873	(98)
Space heating per m2											(98) / (4) =	48.0187	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1449.5904	1141.1669	1169.3039	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7449	0.8174	0.7822	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1079.7345	932.8316	914.6536	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1359.7259	1299.8139	1206.3007	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	201.5938	273.0349	216.9855	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												691.6142	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	50.3985	68.2587	54.2464	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												172.9035	(107)
Space cooling per m2												1.3191	(108)
Energy for space heating												48.0187	(99)
Energy for space cooling												1.3191	(108)
Total												49.3377	(109)
Dwelling Fabric Energy Efficiency (DFEE)												49.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1180	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3680	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3680	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3680	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			18.4400	1.3258	24.4470			(27)
GF B&B J150 P/A=0.50			65.5400	0.1300	8.5202			(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.1800	26.3826			(29a)
Plane Ceiling	65.5400		65.5400	0.1300	8.5202			(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.5560			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1425	(36)
Total fabric heat loss (33) + (36) =	84.6985	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.2205	67.7424	67.2738	65.0727	64.6609	62.7439	62.7439	62.3889	63.4823	64.6609	65.4940	66.3650	(38)
Heat transfer coeff	152.9189	152.4409	151.9722	149.7712	149.3594	147.4424	147.4424	147.0874	148.1808	149.3594	150.1925	151.0634	(39)
Average = Sum(39)m / 12 =												149.7692	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1666	1.1630	1.1594	1.1426	1.1395	1.1248	1.1248	1.1221	1.1305	1.1395	1.1458	1.1525	(40)
HLP (average)												1.1426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)
Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

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If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7117	31.2337	32.2304	28.0992	26.9619	23.2661	21.5594	24.7398	25.0352	29.1761	31.8480	34.5849	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	144.8868	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.5687	25.3745	20.6359	15.6227	11.6782	9.8592	10.6532	13.8475	18.5860	23.5992	27.5438	29.3628	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.0175	302.1204	294.3013	277.6553	256.6427	236.8939	223.7004	220.5976	228.4167	245.0627	266.0752	285.8241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	37.4887	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	47.9997	46.4787	43.3204	39.0267	36.2391	32.3140	28.9777	33.2524	34.7712	39.2152	44.2334	46.4851	(72)
Total internal gains													
	442.0520	440.4397	424.7237	398.7708	371.0260	345.5331	329.7974	334.1634	348.2399	374.3432	404.3185	428.1380	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.6300	0.7000	0.7700	26.4823	(75)
Southwest	10.7600	36.7938	0.6300	0.7000	0.7700	120.9927	(79)

Solar gains	147.4750	260.0008	379.1091	508.8972	605.7533	617.0962	588.4032	513.7405	423.6768	293.6560	178.2429	125.1713	(83)
Total gains	589.5269	700.4404	803.8327	907.6680	976.7793	962.6293	918.2006	847.9039	771.9167	667.9991	582.5614	553.3093	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5268	59.7135	59.8976	60.7779	60.9455	61.7379	61.7379	61.8869	61.4302	60.9455	60.6074	60.2580	
alpha	4.9685	4.9809	4.9932	5.0519	5.0630	5.1159	5.1159	5.1258	5.0953	5.0630	5.0405	5.0172	
util living area													
	0.9995	0.9986	0.9959	0.9846	0.9434	0.8280	0.6667	0.7303	0.9286	0.9920	0.9988	0.9996	(86)
MIT	19.5967	19.7457	19.9964	20.3410	20.6644	20.8945	20.9737	20.9587	20.7802	20.3606	19.9203	19.5786	(87)
Th 2	19.9468	19.9497	19.9526	19.9662	19.9687	19.9806	19.9806	19.9828	19.9760	19.9687	19.9636	19.9582	(88)
util rest of house													
	0.9993	0.9981	0.9942	0.9778	0.9160	0.7464	0.5317	0.5998	0.8819	0.9875	0.9983	0.9995	(89)
MIT 2	18.6585	18.8096	19.0620	19.4139	19.7245	19.9268	19.9732	19.9695	19.8394	19.4378	18.9953	18.6495	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7631	18.9140	19.1662	19.5173	19.8293	20.0347	20.0848	20.0799	19.9444	19.5407	19.0985	18.7531	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9974	0.9925	0.9739	0.9113	0.7515	0.5466	0.6136	0.8800	0.9848	0.9977	0.9993	(94)
Useful gains	588.9201	698.6159	797.8199	883.9420	890.1389	723.3883	501.8578	520.3121	679.3039	657.8365	581.2303	552.9008	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2211.6843	2136.3065	1924.9108	1590.1618	1214.1851	801.3087	513.8094	541.2617	866.0234	1335.3775	1802.0817	2198.4416	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1207.3366	966.1281	838.5556	508.4783	241.0904	0.0000	0.0000	0.0000	0.0000	504.0905	879.0130	1224.2823	(98)
Space heating												6368.9748	(98)
Space heating per m2											(98) / (4) =	48.5885	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1385.9584	1091.0737	1117.8641	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7886	0.8707	0.8341	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1092.9704	949.9688	932.4168	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1245.0551	1190.4749	1110.8358	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	109.5010	178.9365	132.7438	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												421.1813	(104)

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Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	27.3753	44.7341	33.1859	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												105.2953 (107)
Space cooling per m2												0.8033 (108)
Energy for space heating												48.5885 (99)
Energy for space cooling												0.8033 (108)
Total												49.3917 (109)
Target Fabric Energy Efficiency (TFEE)												56.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400	(1b)	x 2.5400	(2b) =	166.4716	(1b) - (3b)
First floor	65.5400	(1c)	x 2.6300	(2c) =	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4180	0.3981	0.3981	0.3682	0.3682	0.3284	0.3384	0.3184	0.3284	0.3483	0.3483	0.3782	(22b)
Effective ac	0.5873	0.5792	0.5792	0.5678	0.5678	0.5539	0.5572	0.5507	0.5539	0.5607	0.5607	0.5715	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.6759	64.7678	64.7678	63.4888	63.4888	61.9385	62.3095	61.5786	61.9385	62.6915	62.6915	63.9041	(38)
Heat transfer coeff	157.1251	156.2171	156.2171	154.9381	154.9381	153.3877	153.7587	153.0279	153.3877	154.1408	154.1408	155.3533	(39)
Average = Sum(39)m / 12 =												154.7194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1987	1.1918	1.1918	1.1820	1.1820	1.1702	1.1730	1.1674	1.1702	1.1759	1.1759	1.1852	(40)
HLP (average)												1.1803	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
RHI water heating demand												2161	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	12.9236	0.4600	0.0000	0.7700	35.1554	(75)
Southwest	6.9600	40.4699	0.4600	0.0000	0.7700	99.7677	(79)
Southwest	3.8000	40.4699	0.4600	0.0000	0.7700	54.4709	(79)

Solar gains	189.3940	301.0775	435.5771	605.9916	705.4184	770.0630	725.9315	646.3477	528.8503	363.6009	234.6261	159.1331	(83)
Total gains	947.7682	1053.7175	1159.7585	1286.0768	1339.9184	1364.3980	1297.3396	1227.7988	1136.1947	1015.2767	935.3772	897.4308	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5881	34.7891	34.7891	35.0763	35.0763	35.4308	35.3453	35.5141	35.4308	35.2577	35.2577	34.9825	
alpha	3.3059	3.3193	3.3193	3.3384	3.3384	3.3621	3.3564	3.3676	3.3621	3.3505	3.3505	3.3322	
util living area													
	0.9744	0.9627	0.9343	0.8666	0.7387	0.5235	0.3592	0.3878	0.6692	0.8845	0.9569	0.9779	(86)
MIT	19.3655	19.5532	19.9176	20.3690	20.7396	20.9449	20.9889	20.9858	20.8648	20.4248	19.8423	19.3412	(87)
Th 2	19.9210	19.9266	19.9266	19.9344	19.9344	19.9439	19.9416	19.9461	19.9439	19.9393	19.9393	19.9319	(88)
util rest of house													
	0.9690	0.9548	0.9199	0.8365	0.6785	0.4269	0.2404	0.2652	0.5804	0.8514	0.9462	0.9732	(89)
MIT 2	17.7770	18.0504	18.5711	19.2031	19.6821	19.9094	19.9385	19.9418	19.8394	19.2955	18.4784	17.7490	(90)
Living area fraction									fLA = Living area / (4) =			0.1115	(91)
MIT	17.9542	18.2180	18.7213	19.3331	19.8001	20.0249	20.0557	20.0582	19.9537	19.4214	18.6305	17.9266	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8042	18.0680	18.5713	19.1831	19.6501	19.8749	19.9057	19.9082	19.8037	19.2714	18.4805	17.7766	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9357	0.8957	0.8105	0.6603	0.4202	0.2362	0.2606	0.5671	0.8250	0.9256	0.9590	(94)
Useful gains	903.5552	986.0073	1038.8457	1042.4039	884.7356	573.2794	306.4956	319.9691	644.3826	837.6061	865.8052	860.6036	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1996.1476	1947.7184	1745.1474	1438.3112	1030.3463	594.3675	308.3917	322.6168	706.1574	1182.4793	1615.4740	1969.3488	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	812.8887	646.2699	525.4884	285.0533	108.3344	0.0000	0.0000	0.0000	0.0000	256.5857	539.7616	824.9064	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3999.2883 (98)
RHI space heating demand	3999 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1476	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3981	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4379	0.4279	0.3782	0.3782	0.3682	0.3981	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5916	0.5715	0.5715	0.5678	0.5792	0.5916	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19564.7510 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.2581 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.9175 (36)
Total fabric heat loss	(33) + (36) =	91.4492 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.3102	69.7510	69.2028	66.6282	66.1465	63.9041	63.9041	63.4888	64.7678	66.1465	67.1210	68.1398	(38)
Heat transfer coeff	161.7594	161.2002	160.6521	158.0774	157.5957	155.3533	155.3533	154.9381	156.2171	157.5957	158.5702	159.5890	(39)
Average = Sum(39)m / 12 =												158.0751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2298	1.2256	1.2060	1.2023	1.1852	1.1852	1.1820	1.1918	1.2023	1.2097	1.2175	(40)
HLP (average)												1.2059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	929.2951	1053.9762	1163.5620	1269.8881	1336.5572	1309.5385	1253.3569	1176.8671	1098.3782	992.0178	907.3315	883.3690	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5971	33.7137	33.8287	34.3797	34.4848	34.9825	34.9825	35.0763	34.7891	34.4848	34.2728	34.0541	
alpha	3.2398	3.2476	3.2552	3.2920	3.2990	3.3322	3.3322	3.3384	3.3193	3.2990	3.2849	3.2703	
util living area													
	0.9791	0.9675	0.9449	0.8946	0.8014	0.6545	0.5099	0.5551	0.7612	0.9148	0.9674	0.9821	(86)
MIT	19.1578	19.3779	19.7323	20.1953	20.5910	20.8571	20.9537	20.9380	20.7486	20.2415	19.6273	19.1270	(87)
Th 2	19.8929	19.8962	19.8996	19.9152	19.9182	19.9319	19.9319	19.9344	19.9266	19.9182	19.9122	19.9060	(88)
util rest of house													
	0.9748	0.9608	0.9331	0.8710	0.7552	0.5740	0.4000	0.4452	0.6918	0.8908	0.9595	0.9784	(89)
MIT 2	17.4583	17.7782	18.2891	18.9514	19.4841	19.8149	19.9070	19.8983	19.6976	19.0300	18.1524	17.4218	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6478	17.9566	18.4500	19.0901	19.6075	19.9311	20.0237	20.0143	19.8148	19.1652	18.3169	17.6120	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4978	17.8066	18.3000	18.9401	19.4575	19.7811	19.8737	19.8643	19.6648	19.0152	18.1669	17.4620	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9607	0.9426	0.9099	0.8443	0.7321	0.5614	0.3936	0.4374	0.6720	0.8644	0.9412	0.9657	(94)
Useful gains	892.7641	993.4769	1058.6781	1072.1217	978.4794	735.1606	493.3150	514.7889	738.1402	857.4732	853.9804	853.0935	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2134.8764	2080.5442	1895.7008	1587.1188	1222.5550	804.9004	508.5866	536.7529	869.3237	1326.1925	1754.8822	2116.4731	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	924.1316	730.5092	622.7449	370.7979	181.5923	0.0000	0.0000	0.0000	0.0000	348.7272	648.6493	939.9545	(98)
Space heating												4767.1068	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2 (98) / (4) = 36.3679 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5273.3482 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	924.1316	730.5092	622.7449	370.7979	181.5923	0.0000	0.0000	0.0000	0.0000	348.7272	648.6493	939.9545	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1022.2694	808.0854	688.8771	410.1747	200.8764	0.0000	0.0000	0.0000	0.0000	385.7602	717.5324	1039.7726	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1749	87.9783	87.5689	86.6469	84.8468	79.7000	79.7000	79.7000	79.7000	86.4054	87.6870	88.2481	(217)
Fuel for water heating, kWh/month	242.6050	214.1498	225.5754	203.8315	203.5915	193.0607	184.8401	203.6183	203.5067	211.9787	221.5325	236.3948	(219)
Water heating fuel used												2544.6849	(219)

Annual totals kWh/year
Space heating fuel - main system 5273.3482 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 75.0000 (231)
Electricity for lighting (calculated in Appendix L) 504.5329 (232)
Total delivered energy for all uses 8397.5660 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5273.3482	3.4800	183.5125	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2544.6849	3.4800	88.5550	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Total energy cost			468.5079	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.1175 (257)
SAP value 84.4106
SAP rating (Section 12) 84 (258)
SAP band B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5273.3482	0.2160	1139.0432	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2544.6849	0.2160	549.6519	(264)
Space and water heating			1688.6952	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total kg/year			1989.4727	(272)
CO2 emissions per m2			15.1800	(273)
EI value			84.8598	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact 0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency 3.48 / 0.8470 = 4.109, stars = 4

Water heating environmental impact 0.216 / 0.8470 = 0.2550, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3981	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4180	0.3981	0.3981	0.3682	0.3682	0.3284	0.3384	0.3184	0.3284	0.3483	0.3483	0.3782	(22b)
Effective ac	0.5873	0.5792	0.5792	0.5678	0.5678	0.5539	0.5572	0.5507	0.5539	0.5607	0.5607	0.5715	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19564.7510 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.2581 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.9175 (36)
Total fabric heat loss	(33) + (36) =	91.4492 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.6759	64.7678	64.7678	63.4888	63.4888	61.9385	62.3095	61.5786	61.9385	62.6915	62.6915	63.9041	(38)
Heat transfer coeff	157.1251	156.2171	156.2171	154.9381	154.9381	153.3877	153.7587	153.0279	153.3877	154.1408	154.1408	155.3533	(39)
Average = Sum(39)m / 12 =												154.7194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1987	1.1918	1.1918	1.1820	1.1820	1.1702	1.1730	1.1674	1.1702	1.1759	1.1759	1.1852	(40)
HLP (average)												1.1803	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
									Total per year (kWh/year) = Sum(64)m =			2160.9060	(64)
Heat gains from water heating, kWh/month													
	92.5675	82.0101	87.1202	79.4726	78.8766	71.9101	70.4233	75.3996	74.6784	82.3412	85.3384	90.8043	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	124.4187	122.0389	117.0971	110.3787	106.0169	99.8752	94.6549	101.3435	103.7200	110.6737	118.5256	122.0488	(72)
Total internal gains													
	758.3742	752.6400	724.1814	680.0853	634.5000	594.3350	571.4081	581.4511	607.3443	651.6758	700.7511	738.2977	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	12.9236	0.4600	0.0000	0.7700	35.1554	(75)
Southwest	6.9600	40.4699	0.4600	0.0000	0.7700	99.7677	(79)
Southwest	3.8000	40.4699	0.4600	0.0000	0.7700	54.4709	(79)

Solar gains	189.3940	301.0775	435.5771	605.9916	705.4184	770.0630	725.9315	646.3477	528.8503	363.6009	234.6261	159.1331	(83)
Total gains	947.7682	1053.7175	1159.7585	1286.0768	1339.9184	1364.3980	1297.3396	1227.7988	1136.1947	1015.2767	935.3772	897.4308	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5881	34.7891	34.7891	35.0763	35.0763	35.4308	35.3453	35.5141	35.4308	35.2577	35.2577	34.9825	
alpha	3.3059	3.3193	3.3193	3.3384	3.3384	3.3621	3.3564	3.3676	3.3621	3.3505	3.3505	3.3322	
util living area													
	0.9744	0.9627	0.9343	0.8666	0.7387	0.5235	0.3592	0.3878	0.6692	0.8845	0.9569	0.9779	(86)
MIT	19.3655	19.5532	19.9176	20.3690	20.7396	20.9449	20.9889	20.9858	20.8648	20.4248	19.8423	19.3412	(87)
Th 2	19.9210	19.9266	19.9266	19.9344	19.9344	19.9439	19.9416	19.9461	19.9439	19.9393	19.9393	19.9319	(88)
util rest of house													
	0.9690	0.9548	0.9199	0.8365	0.6785	0.4269	0.2404	0.2652	0.5804	0.8514	0.9462	0.9732	(89)
MIT 2	17.7770	18.0504	18.5711	19.2031	19.6821	19.9094	19.9385	19.9418	19.8394	19.2955	18.4784	17.7490	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9542	18.2180	18.7213	19.3331	19.8001	20.0249	20.0557	20.0582	19.9537	19.4214	18.6305	17.9266	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8042	18.0680	18.5713	19.1831	19.6501	19.8749	19.9057	19.9082	19.8037	19.2714	18.4805	17.7766	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9357	0.8957	0.8105	0.6603	0.4202	0.2362	0.2606	0.5671	0.8250	0.9256	0.9590	(94)
Useful gains	903.5552	986.0073	1038.8457	1042.4039	884.7356	573.2794	306.4956	319.9691	644.3826	837.6061	865.8052	860.6036	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1996.1476	1947.7184	1745.1474	1438.3112	1030.3463	594.3675	308.3917	322.6168	706.1574	1182.4793	1615.4740	1969.3488	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	812.8887	646.2699	525.4884	285.0533	108.3344	0.0000	0.0000	0.0000	0.0000	256.5857	539.7616	824.9064	(98)
Space heating												3999.2883	(98)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating per m2 (98) / (4) = 30.5103 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4423.9915 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	812.8887	646.2699	525.4884	285.0533	108.3344	0.0000	0.0000	0.0000	0.0000	256.5857	539.7616	824.9064	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	899.2132	714.9003	581.2925	315.3244	119.8389	0.0000	0.0000	0.0000	0.0000	283.8338	597.0814	912.5071	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	213.9167	188.4054	197.5339	176.6137	172.7409	153.8694	147.3175	162.2838	162.1948	183.1609	194.2552	208.6139	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.9404	87.7411	87.2016	85.9839	83.5097	79.7000	79.7000	79.7000	79.7000	85.6127	87.2983	88.0149	(217)
Fuel for water heating, kWh/month	243.2519	214.7288	226.5256	205.4032	206.8512	193.0607	184.8401	203.6183	203.5067	213.9414	222.5188	237.0212	(219)
Water heating fuel used												2555.2678	(219)

Annual totals kWh/year	
Space heating fuel - main system	4423.9915 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	75.0000 (231)
Electricity for lighting (calculated in Appendix L)	504.5329 (232)
Total delivered energy for all uses	7558.7923 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4423.9915	3.9200	173.4205	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2555.2678	3.9200	100.1665	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	504.5329	16.9600	85.5688	(250)
Additional standing charges			88.0000	(251)
Total energy cost			459.8757	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4423.9915	0.2160	955.5822	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2555.2678	0.2160	551.9379	(264)
Space and water heating			1507.5200	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Total kg/year			1808.2976	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4423.9915	1.2200	5397.2696	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2555.2678	1.2200	3117.4268	(264)
Space and water heating			8514.6964	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	504.5329	3.0700	1548.9160	(268)
Primary energy kWh/year			10293.8624	(272)
Primary energy kWh/m2/year			78.5311	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 44	-261 kg (14.4%)
U Solar photovoltaic panels	+ 7.6	-£ 309	-947 kg (61.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.99 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	7.22 kg/m²	A 93	A 94
Total Savings	£353	9.21 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£98	£107	-£8
Mains gas	£362	£310	£52
Space heating	£274	£275	-£1
Water heating	£100	£55	£45
Lighting	£86	£86	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£460	£108	£353
Total cost of uses	£460	£107	£353
Delivered energy	58 kWh/m²	34 kWh/m²	24 kWh/m²
Carbon dioxide emissions	1.8 tonnes	0.6 tonnes	1.2 tonnes
CO2 emissions per m²	14 kg/m²	5 kg/m²	9 kg/m²
Primary energy	79 kWh/m²	25 kWh/m²	54 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400	(1b)	x 2.5400	(2b) =	166.4716	(1b) - (3b)
First floor	65.5400	(1c)	x 2.6300	(2c) =	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5075	0.4976	0.4876	0.4379	0.4279	0.3782	0.3782	0.3682	0.3981	0.4279	0.4478	0.4677	(22b)
Effective ac	0.6288	0.6238	0.6189	0.5959	0.5916	0.5715	0.5715	0.5678	0.5792	0.5916	0.6003	0.6094	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19564.7510	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	149.2581	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.9175	(36)
Total fabric heat loss	(33) + (36) = 91.4492	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.3102	69.7510	69.2028	66.6282	66.1465	63.9041	63.9041	63.4888	64.7678	66.1465	67.1210	68.1398	(38)
Heat transfer coeff	161.7594	161.2002	160.6521	158.0774	157.5957	155.3533	155.3533	154.9381	156.2171	157.5957	158.5702	159.5890	(39)
Average = Sum(39)m / 12 =												158.0751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2341	1.2298	1.2256	1.2060	1.2023	1.1852	1.1852	1.1820	1.1918	1.2023	1.2097	1.2175	(40)
HLP (average)												1.2059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1189	(H8)
Utilisation factor												0.5909	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-942.2780	(H17)
Solar input	-27.3242	-45.5962	-77.6556	-104.0738	-128.5744	-126.4091	-124.7385	-108.9847	-85.3569	-58.2887	-32.4104	-22.8657	(63)
										Solar input (sum of months) = Sum(63)m =		-942.2780	(63)
Output from w/h													
	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
										Total per year (kWh/year) = Sum(64)m =		1060.5180	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	11.2829	0.4600	0.0000	0.7700	30.6925	(75)
Southwest	6.9600	36.7938	0.4600	0.0000	0.7700	90.7053	(79)
Southwest	3.8000	36.7938	0.4600	0.0000	0.7700	49.5230	(79)

Solar gains	170.9208	301.3362	439.3806	589.8028	702.0572	715.2035	681.9488	595.4160	491.0339	340.3420	206.5804	145.0713	(83)
Total gains	920.8350	1045.5162	1153.6012	1253.9240	1314.3398	1287.0710	1230.8894	1155.4001	1083.9149	982.0569	898.8714	874.9089	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5971	33.7137	33.8287	34.3797	34.4848	34.9825	34.9825	35.0763	34.7891	34.4848	34.2728	34.0541	
alpha	3.2398	3.2476	3.2552	3.2920	3.2990	3.3322	3.3322	3.3384	3.3193	3.2990	3.2849	3.2703	
util living area													
	0.9796	0.9682	0.9460	0.8975	0.8073	0.6620	0.5176	0.5631	0.7663	0.9168	0.9682	0.9826	(86)
MIT	19.1497	19.3703	19.7240	20.1843	20.5805	20.8519	20.9516	20.9353	20.7429	20.2341	19.6196	19.1188	(87)
Th 2	19.8929	19.8962	19.8996	19.9152	19.9182	19.9319	19.9319	19.9344	19.9266	19.9182	19.9122	19.9060	(88)
util rest of house													
	0.9754	0.9616	0.9345	0.8743	0.7617	0.5816	0.4066	0.4525	0.6975	0.8932	0.9605	0.9789	(89)
MIT 2	17.4467	17.7672	18.2774	18.9367	19.4717	19.8101	19.9057	19.8966	19.6917	19.0201	18.1414	17.4101	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.6367	17.9460	18.4388	19.0759	19.5953	19.9263	20.0224	20.0124	19.8090	19.1555	18.3063	17.6007	(92)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.4867	17.7960	18.2888	18.9259	19.4453	19.7763	19.8724	19.8624	19.6590	19.0055	18.1563	17.4507	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9615	0.9436	0.9114	0.8477	0.7382	0.5686	0.4000	0.4444	0.6773	0.8669	0.9424	0.9665	(94)
Useful gains	885.4096	986.5677	1051.4114	1062.9217	970.3077	731.7759	492.3566	513.4475	734.1413	851.3043	847.1122	845.6150	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2133.0702	2078.8349	1893.8915	1584.8654	1220.6323	804.1577	508.3771	536.4600	868.4045	1324.6757	1753.2006	2114.6600	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	928.2595	734.0035	626.8052	375.7994	186.2415	0.0000	0.0000	0.0000	0.0000	352.1883	652.3836	944.1695	(98)
Space heating												4799.8506	(98)
Space heating per m2											(98) / (4) =	36.6177	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5309.5692	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	928.2595	734.0035	626.8052	375.7994	186.2415	0.0000	0.0000	0.0000	0.0000	352.1883	652.3836	944.1695	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1026.8358	811.9508	693.3686	415.7073	206.0193	0.0000	0.0000	0.0000	0.0000	389.5889	721.6633	1044.4352	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	178.7246	135.7027	110.6147	58.1723	23.5044	7.2395	1.6842	33.3348	63.8211	115.6086	154.2307	177.8804	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4821	88.5452	88.6154	88.8019	89.0601	79.7000	79.7000	79.7000	79.7000	87.4970	88.1375	88.5161	(217)
Fuel for water heating, kWh/month	201.9895	153.2582	124.8256	65.5080	26.3916	9.0834	2.1132	41.8254	80.0766	132.1287	174.9887	200.9583	(219)
Water heating fuel used												1213.1472	(219)
Annual totals kWh/year													
Space heating fuel - main system												5309.5692	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												5425.0099	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5309.5692	3.4800	184.7730	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1213.1472	3.4800	42.2175	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	504.5329	13.1900	66.5479	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			202.2030	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4823	(257)
SAP value		93.2718	
SAP rating (Section 12)		93	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5309.5692	0.2160	1146.8670	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1213.1472	0.2160	262.0398	(264)
Space and water heating			1408.9067	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	504.5329	0.5190	261.8526	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			839.1971	(272)
CO2 emissions per m2			6.4000	(273)
EI value			93.6136	
EI rating			94	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.5400 (1b)	x	2.5400 (2b)	=	166.4716	(1b) - (3b)
First floor	65.5400 (1c)	x	2.6300 (2c)	=	172.3702	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	338.8418	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3981	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3981	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4180	0.3981	0.3981	0.3682	0.3682	0.3284	0.3384	0.3184	0.3284	0.3483	0.3483	0.3782	(22b)
Effective ac	0.5873	0.5792	0.5792	0.5678	0.5678	0.5539	0.5572	0.5507	0.5539	0.5607	0.5607	0.5715	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			14.6400	1.2357	18.0913			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			65.5400	0.1200	7.8648	75.0000	4915.5000	(28a)
EW Brick AAC015	169.2700	22.7000	146.5700	0.2500	36.6425	52.3000	7665.6110	(29a)
Plane Ceiling	65.5400		65.5400	0.1600	10.4864	9.0000	589.8600	(30)
Total net area of external elements Aum(A, m2)			300.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5318			(33)
GF Timber			54.6100			9.0000	491.4900	(32c)
1F Timber			134.1900			9.0000	1207.7100	(32c)
GF Masonry			39.0000			75.0000	2925.0000	(32c)
Internal Floor			65.5400			18.0000	1179.7200	(32d)
Internal Ceiling			65.5400			9.0000	589.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19564.7510 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.2581 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.9175 (36)
Total fabric heat loss	(33) + (36) =	91.4492 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.6759	64.7678	64.7678	63.4888	63.4888	61.9385	62.3095	61.5786	61.9385	62.6915	62.6915	63.9041	(38)
Heat transfer coeff	157.1251	156.2171	156.2171	154.9381	154.9381	153.3877	153.7587	153.0279	153.3877	154.1408	154.1408	155.3533	(39)
Average = Sum(39)m / 12 =												154.7194	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1987	1.1918	1.1918	1.1820	1.1820	1.1702	1.1730	1.1674	1.1702	1.1759	1.1759	1.1852	(40)
HLP (average)												1.1803	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8977 (42)
Average daily hot water use (litres/day)	103.0212 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3233	109.2025	105.0817	100.9608	96.8400	92.7191	92.7191	96.8400	100.9608	105.0817	109.2025	113.3233	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	168.0553	146.9822	151.6725	132.2317	126.8795	109.4874	101.4561	116.4224	117.8128	137.2995	149.8732	162.7525	(45)
Energy content (annual)										Total = Sum(45)m =		1620.9250	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2083	22.0473	22.7509	19.8348	19.0319	16.4231	15.2184	17.4634	17.6719	20.5949	22.4810	24.4129	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.0488	181.2989	188.2703	162.2461	152.0787	133.6486	126.4227	142.3195	149.1779	173.8973	186.6411	200.7461	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1817	(H8)
Utilisation factor												0.5710	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0212	(H14)
Volume ratio Veff/V												1.0629	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-961.6433	(H17)
Solar input	-29.5989	-44.4871	-74.9219	-103.5650	-124.7271	-131.2698	-128.1178	-114.4099	-89.2974	-60.7473	-35.9782	-24.5229	(63)
										Solar input (sum of months) = Sum(63)m =		-961.6433	(63)
Output from w/h													
	176.4499	136.8119	113.3484	58.6811	27.3517	2.3788	0.0000	27.9095	59.8805	113.1500	150.6629	176.2232	(64)
										Total per year (kWh/year) = Sum(64)m =		1042.8478	(64)
Heat gains from water heating, kWh/month													
	86.2732	76.3250	79.7093	67.9785	62.3468	55.7335	53.7074	59.4281	64.2648	74.9303	79.2472	84.5101	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	173.8641	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.4219	63.4363	51.5898	39.0568	29.1954	24.6480	26.6330	34.6186	46.4651	58.9981	68.8595	73.4069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	446.2948	450.9260	439.2556	414.4109	383.0488	353.5729	333.8812	329.2501	340.9204	365.7652	397.1272	426.6031	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	55.2842	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	-115.9094	(71)
Water heating gains (Table 5)													
	115.9586	113.5788	107.1362	94.4146	83.7995	77.4077	72.1874	79.8765	89.2567	100.7128	110.0655	113.5888	(72)
Total internal gains													
	749.9142	744.1799	714.2205	664.1212	612.2826	571.8675	548.9406	559.9841	592.8811	641.7149	692.2911	729.8377	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6800	12.9236	0.4600	0.0000	0.7700	35.1554	(75)
Southwest	6.9600	40.4699	0.4600	0.0000	0.7700	99.7677	(79)
Southwest	3.8000	40.4699	0.4600	0.0000	0.7700	54.4709	(79)

Solar gains	189.3940	301.0775	435.5771	605.9916	705.4184	770.0630	725.9315	646.3477	528.8503	363.6009	234.6261	159.1331	(83)
Total gains	939.3082	1045.2574	1149.7977	1270.1128	1317.7010	1341.9305	1274.8721	1206.3318	1121.7314	1005.3158	926.9172	888.9708	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5881	34.7891	34.7891	35.0763	35.0763	35.4308	35.3453	35.5141	35.4308	35.2577	35.2577	34.9825	
alpha	3.3059	3.3193	3.3193	3.3384	3.3384	3.3621	3.3564	3.3676	3.3621	3.3505	3.3505	3.3322	
util living area													
	0.9750	0.9635	0.9357	0.8701	0.7454	0.5306	0.3651	0.3941	0.6748	0.8870	0.9579	0.9785	(86)
MIT	19.3576	19.5456	19.9095	20.3591	20.7318	20.9426	20.9884	20.9851	20.8612	20.4182	19.8348	19.3331	(87)
Th 2	19.9210	19.9266	19.9266	19.9344	19.9344	19.9439	19.9416	19.9461	19.9439	19.9393	19.9393	19.9319	(88)
util rest of house													
	0.9697	0.9558	0.9215	0.8404	0.6857	0.4333	0.2446	0.2698	0.5860	0.8544	0.9475	0.9739	(89)
MIT 2	17.7656	18.0396	18.5600	19.1904	19.6736	19.9079	19.9384	19.9415	19.8362	19.2870	18.4679	17.7374	(90)
Living area fraction										fLA = Living area / (4) =		0.1115	(91)
MIT	17.9432	18.2076	18.7105	19.3207	19.7916	20.0233	20.0555	20.0579	19.9506	19.4132	18.6204	17.9154	(92)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.7932	18.0576	18.5605	19.1707	19.6416	19.8733	19.9055	19.9079	19.8006	19.2632	18.4704	17.7654	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9369	0.8975	0.8144	0.6670	0.4263	0.2403	0.2651	0.5725	0.8279	0.9271	0.9599	(94)
Useful gains	896.3984	979.2792	1031.9586	1034.3601	878.9579	572.0926	306.3599	319.7813	642.1624	832.3119	859.3180	853.3106	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1994.4174	1946.0860	1743.4652	1436.3882	1029.0418	594.1138	308.3588	322.5723	705.6700	1181.2088	1613.9093	1967.6053	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	816.9261	649.6941	529.3609	289.4602	111.6624	0.0000	0.0000	0.0000	0.0000	259.5793	543.3057	829.0352	(98)
Space heating												4029.0240	(98)
Space heating per m2											(98) / (4) =	30.7371	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4456.8849	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	816.9261	649.6941	529.3609	289.4602	111.6624	0.0000	0.0000	0.0000	0.0000	259.5793	543.3057	829.0352	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	903.6793	718.6882	585.5762	320.1994	123.5204	0.0000	0.0000	0.0000	0.0000	287.1452	601.0019	917.0743	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	176.4499	136.8119	113.3484	58.6811	27.3517	2.3788	0.0000	27.9095	59.8805	113.1500	150.6629	176.2232	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.2944	88.3370	88.3091	88.3996	88.0735	79.7000	79.7000	79.7000	79.7000	86.8600	87.8397	88.3214	(217)
Fuel for water heating, kWh/month	199.8426	154.8748	128.3541	66.3816	31.0555	2.9846	0.0000	35.0182	75.1324	130.2671	171.5201	199.5250	(219)
Water heating fuel used												1194.9562	(219)
Annual totals kWh/year													
Space heating fuel - main system												4456.8849	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												504.5329	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												4457.2144	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4456.8849	3.9200	174.7099	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1194.9562	3.9200	46.8423	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	504.5329	16.9600	85.5688	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			106.9435	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4456.8849	0.2160	962.6871	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1194.9562	0.2160	258.1105	(264)
Space and water heating			1220.7977	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	504.5329	0.5190	261.8526 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			600.7864 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4456.8849	1.2200	5437.3996 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1194.9562	1.2200	1457.8466 (264)
Space and water heating			6895.2462 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	504.5329	3.0700	1548.9160 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			3227.7421 (272)
Primary energy kWh/m2/year			24.6242 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	149.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	447.27 (P1)
Transmission heat loss coefficient	91.45 (37)
Summer heat loss coefficient	538.72 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.6800	98.8453	0.4600	0.0000	0.9000	314.2805
South West	6.9600	119.9223	0.4600	0.0000	0.9000	345.5490
South West	3.8000	119.9223	0.4600	0.0000	0.9000	188.6618
total:						848.4914

	Jun	Jul	Aug	
Solar gains	900	848	755	(P4)
Internal gains	591	568	578	
Total summer gains	1491	1417	1334	(P5)
Summer gain/loss ratio	2.77	2.63	2.48	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 149.3)	0.96	0.96	0.96	
Threshold temperature	19.72	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-329	**Issued on Date**	19/10/2022
Assessment Reference	Plot 329	**Prop Type Ref**	Islington-As-DET
Property	Plot 329, 3 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.83	**TER**	18.80
Environmental	85 B	**% DER<TER**	5.14		
CO_2 Emissions (t/year)	1.48	**DFEE**	52.66	**TFEE**	59.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.86		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.83 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.7 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 6.36 m², No overhang
Windows facing South West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	560.6773	661.1806	755.3521	850.7274	915.4613	902.0110	859.5809	796.3376	725.2740	630.5153	553.8114	527.3462	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9913	0.9846	0.9704	0.9352	0.8614	0.7319	0.5909	0.6431	0.8402	0.9552	0.9858	0.9929	(86)
MIT	18.8928	19.1201	19.4973	20.0067	20.4637	20.7947	20.9271	20.9022	20.6429	20.0488	19.3905	18.8685	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9893	0.9809	0.9629	0.9176	0.8205	0.6483	0.4634	0.5190	0.7775	0.9396	0.9818	0.9912	(89)
MIT 2	17.0160	17.3489	17.8978	18.6374	19.2673	19.6911	19.8218	19.8067	19.5206	18.7105	17.7563	16.9898	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3424	17.6570	18.1760	18.8756	19.4754	19.8831	20.0141	19.9972	19.7158	18.9433	18.0405	17.3166	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1924	17.5070	18.0260	18.7256	19.3254	19.7331	19.8641	19.8472	19.5658	18.7933	17.8905	17.1666	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9819	0.9699	0.9464	0.8949	0.7978	0.6376	0.4639	0.5170	0.7578	0.9193	0.9713	0.9850	(94)
Useful gains	550.5504	641.2722	714.8403	761.2836	730.3556	575.1029	398.7567	411.6945	549.6350	579.6317	537.9173	519.4283	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1735.6072	1690.4851	1539.5321	1288.3775	996.3905	659.7921	419.5561	441.7381	707.0436	1070.5971	1419.9628	1718.8597	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	881.6823	705.0711	613.5708	379.5076	197.9299	0.0000	0.0000	0.0000	0.0000	365.2782	635.0728	892.3769	(98)
Space heating												4670.4896	(98)
Space heating per m2											(98) / (4) =	46.3434	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5160.7619	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	881.6823	705.0711	613.5708	379.5076	197.9299	0.0000	0.0000	0.0000	0.0000	365.2782	635.0728	892.3769	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	974.2345	779.0840	677.9787	419.3454	218.7071	0.0000	0.0000	0.0000	0.0000	403.6224	701.7379	986.0518	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9504	89.9072	89.8174	89.6091	89.1660	87.3000	87.3000	87.3000	87.3000	89.5598	89.8429	89.9691	(217)
Fuel for water heating, kWh/month													
	196.0489	171.9859	178.6924	157.6142	153.0750	136.5557	128.1658	144.7599	145.8047	163.6797	176.2102	190.3060	(219)
Water heating fuel used												1942.8983	(219)
Annual totals kWh/year													
Space heating fuel - main system												5160.7619	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												7609.8428	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5160.7619	0.2160	1114.7246	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.8983	0.2160	419.6660	(264)
Space and water heating			1534.3906	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/year			1797.0994	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.8300	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		34.8105	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.8105	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625	(83)
Total gains	554.6334	641.0309	720.1582	798.5811	850.2411	834.6064	795.8466	742.8409	683.9939	606.1341	543.9251	524.0983	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9986	0.9970	0.9923	0.9759	0.9242	0.7966	0.6339	0.6911	0.9013	0.9851	0.9972	0.9990	(86)
MIT	19.5814	19.7340	19.9922	20.3470	20.6730	20.8992	20.9746	20.9618	20.7947	20.3750	19.9209	19.5641	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9981	0.9959	0.9894	0.9657	0.8895	0.7071	0.4953	0.5551	0.8421	0.9770	0.9960	0.9986	(89)
MIT 2	17.9911	18.2165	18.5950	19.1175	19.5683	19.8481	19.9102	19.9059	19.7376	19.1650	18.5015	17.9751	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9938	0.9853	0.9585	0.8838	0.7175	0.5193	0.5781	0.8426	0.9713	0.9940	0.9977	(94)
Useful gains	552.9672	637.0497	709.5866	765.4202	751.4169	598.8320	413.2815	429.4638	576.3338	588.7382	540.6688	522.8967	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1759.7186	1704.9358	1543.6154	1283.8461	988.9717	656.7301	422.6712	444.9405	707.9237	1076.7071	1438.1713	1746.1794	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating												4705.3404	(98)
Space heating per m2											(98) / (4) =	46.6892	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5037.8377	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	961.2666	768.3292	664.3655	399.6431	189.2299	0.0000	0.0000	0.0000	0.0000	388.7033	691.8649	974.4351	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2698	88.1007	87.7372	86.9019	85.1478	80.3000	80.3000	80.3000	80.3000	86.7375	87.8490	88.3328	(217)
Fuel for water heating, kWh/month													
	241.4868	213.2667	224.9306	202.1588	199.7575	186.5567	178.7355	199.2482	201.4487	211.5298	220.7962	235.5205	(219)
Water heating fuel used												2515.4359	(219)
Annual totals kWh/year													
Space heating fuel - main system												5037.8377	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8059.4561	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5037.8377	0.2160	1088.1729	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.4359	0.2160	543.3341	(264)
Space and water heating			1631.5071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1894.2158	(272)
Emissions per m2 for space and water heating			16.1888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1888 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4040	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4040	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5152	0.5051	0.4950	0.4444	0.4343	0.3838	0.3838	0.3737	0.4040	0.4343	0.4545	0.4747	(22b)
Effective ac	0.6327	0.6275	0.6225	0.5988	0.5943	0.5737	0.5737	0.5698	0.5816	0.5943	0.6033	0.6127	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3927	53.9497	53.5155	51.4761	51.0946	49.3183	49.3183	48.9894	50.0025	51.0946	51.8665	52.6735	(38)
Heat transfer coeff	132.3518	131.9088	131.4746	129.4352	129.0536	127.2774	127.2774	126.9484	127.9615	129.0536	129.8255	130.6325	(39)
Average = Sum(39)m / 12 =												129.4334	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3133	1.3089	1.3046	1.2843	1.2805	1.2629	1.2629	1.2597	1.2697	1.2805	1.2882	1.2962	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	526.7625	628.0989	724.0004	821.7304	887.9950	876.6975	836.0939	770.5068	698.6077	601.4122	521.9596	494.2610	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7887	33.9022	34.0142	34.5501	34.6523	35.1359	35.1359	35.2269	34.9480	34.6523	34.4462	34.2334	
alpha	3.2526	3.2601	3.2676	3.3033	3.3102	3.3424	3.3424	3.3485	3.3299	3.3102	3.2964	3.2822	
util living area													
	0.9928	0.9867	0.9734	0.9398	0.8680	0.7407	0.5995	0.6544	0.8498	0.9600	0.9880	0.9942	(86)
MIT	18.8876	19.1150	19.4923	19.9990	20.4581	20.7905	20.9255	20.8988	20.6339	20.0348	19.3764	18.8587	(87)
Th 2	19.8305	19.8339	19.8373	19.8531	19.8561	19.8700	19.8700	19.8726	19.8646	19.8561	19.8501	19.8438	(88)
util rest of house													
	0.9911	0.9835	0.9666	0.9233	0.8285	0.6582	0.4723	0.5307	0.7895	0.9460	0.9846	0.9928	(89)
MIT 2	17.9107	18.1392	18.5153	19.0222	19.4562	19.7513	19.8429	19.8321	19.6291	19.0665	18.4123	17.8915	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0806	18.3089	18.6852	19.1921	19.6305	19.9320	20.0313	20.0177	19.8039	19.2350	18.5800	18.0597	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0806	18.3089	18.6852	19.1921	19.6305	19.9320	20.0313	20.0177	19.8039	19.2350	18.5800	18.0597	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9874	0.9777	0.9577	0.9112	0.8193	0.6634	0.4921	0.5485	0.7856	0.9357	0.9793	0.9897	(94)
Useful gains	520.1339	614.0729	693.3552	748.7858	727.4951	581.5721	411.4112	422.5876	548.8193	562.7647	511.1663	489.1737	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1823.8857	1768.7518	1602.0473	1332.1556	1023.4601	678.6474	436.7210	459.2552	729.8811	1114.3720	1490.4019	1810.5297	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	969.9913	775.9442	676.0669	420.0262	220.1980	0.0000	0.0000	0.0000	0.0000	410.3959	705.0496	983.0889	(98)
Space heating												5160.7610	(98)
Space heating per m2											(98) / (4) =	51.2082	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1196.4072	941.8525	964.8080	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7476	0.8197	0.7861	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.3903	772.0217	758.4036	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1130.8406	1081.1498	1006.5616	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	170.2442	229.9913	184.6296	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												584.8650	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.5610	57.4978	46.1574	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												146.2162	(107)
Space cooling per m2												1.4508	(108)
Energy for space heating												51.2082	(99)
Energy for space cooling												1.4508	(108)
Total												52.6590	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652 (71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658 (72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625 (83)
Total gains	508.3486	595.5751	676.4238	757.6246	811.4850	798.6707	761.7292	705.7127	645.3569	564.6371	499.6931	478.6391 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9990	0.9978	0.9941	0.9803	0.9348	0.8160	0.6565	0.7172	0.9173	0.9888	0.9980	0.9993	(86)
MIT	19.5393	19.6930	19.9535	20.3133	20.6479	20.8871	20.9705	20.9551	20.7721	20.3393	19.8808	19.5225	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9987	0.9970	0.9918	0.9718	0.9036	0.7292	0.5157	0.5806	0.8642	0.9825	0.9972	0.9991	(89)
MIT 2	18.5484	18.7045	18.9667	19.3345	19.6542	19.8639	19.9121	19.9088	19.7769	19.3656	18.9052	18.5423	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9959	0.9896	0.9676	0.9008	0.7405	0.5404	0.6042	0.8664	0.9795	0.9963	0.9987	(94)
Useful gains	507.4319	593.1621	669.3910	733.1045	730.9497	591.3996	411.6494	426.4181	559.1304	553.0788	497.8355	477.9976	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1816.7931	1754.6483	1581.1855	1305.1901	997.1450	658.0460	422.7717	445.0917	711.3938	1096.2806	1478.4834	1803.5035	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	974.1647	780.5187	678.3751	411.9016	198.0493	0.0000	0.0000	0.0000	0.0000	404.1421	706.0665	986.1764	(98)
Space heating												5139.3944	(98)
Space heating per m2											(98) / (4) =	50.9962	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7903	0.8699	0.8360	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	898.3316	778.3744	766.1862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.6404	994.2300	930.8283	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	101.7424	160.5966	122.4937	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												384.8327	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	25.4356	40.1491	30.6234	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												96.2082 (107)
Space cooling per m2												0.9546 (108)
Energy for space heating												50.9962 (99)
Energy for space cooling												0.9546 (108)
Total												51.9508 (109)
Target Fabric Energy Efficiency (TFEE)												59.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	12.9236	0.4600	0.0000	0.7700	29.1131	(75)
Southwest	5.0200	40.4699	0.4600	0.0000	0.7700	71.9589	(79)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	148.8057	237.0155	344.0420	480.4457	560.7064	612.7102	577.3487	513.0418	418.3571	286.5717	184.4403	124.9696	(83)
Total gains	783.6970	866.7707	948.8415	1046.6335	1087.2291	1104.0139	1048.3393	993.3372	921.1312	828.1847	769.0893	742.3030	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9742	0.9629	0.9356	0.8704	0.7458	0.5320	0.3666	0.3950	0.6769	0.8873	0.9571	0.9776	(86)
MIT	19.3551	19.5402	19.9009	20.3532	20.7289	20.9416	20.9881	20.9848	20.8588	20.4137	19.8343	19.3344	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9683	0.9545	0.9204	0.8387	0.6818	0.4278	0.2374	0.2620	0.5818	0.8523	0.9457	0.9725	(89)
MIT 2	17.7061	17.9761	18.4911	19.1241	19.6071	19.8403	19.8690	19.8733	19.7701	19.2241	18.4129	17.6848	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9929	18.2482	18.7363	19.3379	19.8023	20.0319	20.0637	20.0667	19.9595	19.4310	18.6601	17.9717	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8429	18.0982	18.5863	19.1879	19.6523	19.8819	19.9137	19.9167	19.8095	19.2810	18.5101	17.8217	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9365	0.8981	0.8156	0.6683	0.4285	0.2423	0.2668	0.5756	0.8292	0.9266	0.9590	(94)
Useful gains	747.1714	811.7740	852.1369	853.6471	726.5531	473.0663	254.0597	265.0108	530.1646	686.6961	712.6262	711.8351	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1659.3877	1616.7422	1447.0439	1190.1832	852.4436	491.7198	255.7849	267.3952	583.8875	978.4535	1338.8417	1635.2224	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating												3353.1497	(98)
RHI space heating demand												3353	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9788	0.9677	0.9462	0.8980	0.8081	0.6635	0.5195	0.5641	0.7684	0.9171	0.9675	0.9818	(86)
MIT	19.1382	19.3544	19.7063	20.1731	20.5738	20.8492	20.9504	20.9342	20.7377	20.2251	19.6122	19.1116	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9741	0.9606	0.9338	0.8732	0.7592	0.5772	0.4004	0.4455	0.6946	0.8917	0.9591	0.9778	(89)
MIT 2	17.3708	17.6851	18.1926	18.8615	19.3999	19.7412	19.8353	19.8273	19.6220	18.9491	18.0735	17.3421	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6782	17.9754	18.4559	19.0896	19.6041	19.9340	20.0293	20.0198	19.8161	19.1710	18.3411	17.6499	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5282	17.8254	18.3059	18.9396	19.4541	19.7840	19.8793	19.8698	19.6661	19.0210	18.1911	17.4999	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9434	0.9121	0.8490	0.7398	0.5708	0.4025	0.4462	0.6804	0.8679	0.9419	0.9656	(94)
Useful gains	738.8506	817.7852	868.0076	877.4228	802.1829	605.1060	407.8038	425.1167	606.1943	702.7790	703.5589	706.0990	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1780.8121	1733.1852	1576.9181	1316.4450	1013.2141	666.3357	421.5104	444.6365	720.0161	1100.3578	1459.5194	1763.0500	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating												4017.3626	(98)
Space heating per m2											(98) / (4) =	39.8627	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4439.0747	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	856.5960	679.7225	582.7950	349.2773	173.4887	0.0000	0.0000	0.0000	0.0000	326.8494	601.4271	868.9188	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8894	89.8385	89.7326	89.4870	88.9832	87.3000	87.3000	87.3000	87.3000	89.4140	89.7587	89.9107	(217)
Fuel for water heating, kWh/month													
	196.1821	172.1175	178.8612	157.8293	153.3896	136.5557	128.1658	144.7599	145.8047	163.9467	176.3755	190.4295	(219)
Water heating fuel used												1944.4175	(219)
Annual totals kWh/year													
Space heating fuel - main system												4439.0747	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6889.6747	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4439.0747	3.4800	154.4798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.4175	3.4800	67.6657	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Total energy cost			408.9110	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1781	(257)
SAP value		83.5656	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4439.0747	0.2160	958.8401	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.4175	0.2160	419.9942	(264)
Space and water heating			1378.8343	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1641.5431	(272)
CO2 emissions per m2			16.2900	(273)
EI value			84.9110	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	12.9236	0.4600	0.0000	0.7700	29.1131	(75)
Southwest	5.0200	40.4699	0.4600	0.0000	0.7700	71.9589	(79)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	148.8057	237.0155	344.0420	480.4457	560.7064	612.7102	577.3487	513.0418	418.3571	286.5717	184.4403	124.9696	(83)
Total gains	783.6970	866.7707	948.8415	1046.6335	1087.2291	1104.0139	1048.3393	993.3372	921.1312	828.1847	769.0893	742.3030	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9742	0.9629	0.9356	0.8704	0.7458	0.5320	0.3666	0.3950	0.6769	0.8873	0.9571	0.9776	(86)
MIT	19.3551	19.5402	19.9009	20.3532	20.7289	20.9416	20.9881	20.9848	20.8588	20.4137	19.8343	19.3344	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9683	0.9545	0.9204	0.8387	0.6818	0.4278	0.2374	0.2620	0.5818	0.8523	0.9457	0.9725	(89)
MIT 2	17.7061	17.9761	18.4911	19.1241	19.6071	19.8403	19.8690	19.8733	19.7701	19.2241	18.4129	17.6848	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9929	18.2482	18.7363	19.3379	19.8023	20.0319	20.0637	20.0667	19.9595	19.4310	18.6601	17.9717	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8429	18.0982	18.5863	19.1879	19.6523	19.8819	19.9137	19.9167	19.8095	19.2810	18.5101	17.8217	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9365	0.8981	0.8156	0.6683	0.4285	0.2423	0.2668	0.5756	0.8292	0.9266	0.9590	(94)
Useful gains	747.1714	811.7740	852.1369	853.6471	726.5531	473.0663	254.0597	265.0108	530.1646	686.6961	712.6262	711.8351	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1659.3877	1616.7422	1447.0439	1190.1832	852.4436	491.7198	255.7849	267.3952	583.8875	978.4535	1338.8417	1635.2224	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating												3353.1497	(98)
Space heating per m2											(98) / (4) =	33.2720	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3705.1378	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	749.9325	597.7222	489.0727	267.7414	103.4945	0.0000	0.0000	0.0000	0.0000	239.8536	498.2046	759.1162	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8210	89.7685	89.6257	89.2947	88.5746	87.3000	87.3000	87.3000	87.3000	89.1823	89.6461	89.8430	(217)
Fuel for water heating, kWh/month													
	196.3315	172.2517	179.0745	158.1692	154.0972	136.5557	128.1658	144.7599	145.8047	164.3727	176.5970	190.5731	(219)
Water heating fuel used												1946.7530	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.1378	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6158.0733	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3705.1378	3.9200	145.2414	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.7530	3.9200	76.3127	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Total energy cost			395.4027	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3705.1378	0.2160	800.3098	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.7530	0.2160	420.4986	(264)
Space and water heating			1220.8084	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1483.5172	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3705.1378	1.2200	4520.2681	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.7530	1.2200	2375.0387	(264)
Space and water heating			6895.3067	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Primary energy kWh/year			8449.2872	(272)
Primary energy kWh/m2/year			83.8389	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 85

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-189 kg (12.8%)
U Solar photovoltaic panels	+ 9.2	-£ 309	-947 kg (73.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.88 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.39 kg/m²	A 94	A 95
Total Savings	£340	11.27 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£86	£94	-£8
Mains gas	£310	£270	£39
Space heating	£246	£246	£0
Water heating	£76	£46	£31
Lighting	£73	£73	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£396	£55	£340
Total cost of uses	£395	£56	£340
Delivered energy	61 kWh/m²	34 kWh/m²	27 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	11 kg/m²
Primary energy	84 kWh/m²	18 kWh/m²	66 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9788	0.9677	0.9462	0.8980	0.8081	0.6635	0.5195	0.5641	0.7684	0.9171	0.9675	0.9818	(86)
MIT	19.1382	19.3544	19.7063	20.1731	20.5738	20.8492	20.9504	20.9342	20.7377	20.2251	19.6122	19.1116	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9741	0.9606	0.9338	0.8732	0.7592	0.5772	0.4004	0.4455	0.6946	0.8917	0.9591	0.9778	(89)
MIT 2	17.3708	17.6851	18.1926	18.8615	19.3999	19.7412	19.8353	19.8273	19.6220	18.9491	18.0735	17.3421	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6782	17.9754	18.4559	19.0896	19.6041	19.9340	20.0293	20.0198	19.8161	19.1710	18.3411	17.6499	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5282	17.8254	18.3059	18.9396	19.4541	19.7840	19.8793	19.8698	19.6661	19.0210	18.1911	17.4999	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9434	0.9121	0.8490	0.7398	0.5708	0.4025	0.4462	0.6804	0.8679	0.9419	0.9656	(94)
Useful gains	738.8506	817.7852	868.0076	877.4228	802.1829	605.1060	407.8038	425.1167	606.1943	702.7790	703.5589	706.0990	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1780.8121	1733.1852	1576.9181	1316.4450	1013.2141	666.3357	421.5104	444.6365	720.0161	1100.3578	1459.5194	1763.0500	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating												4017.3626	(98)
Space heating per m2											(98) / (4) =	39.8627	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4439.0747	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	856.5960	679.7225	582.7950	349.2773	173.4887	0.0000	0.0000	0.0000	0.0000	326.8494	601.4271	868.9188	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9620	89.9898	90.0244	90.0870	90.1631	87.3000	87.3000	87.3000	87.3000	89.7147	89.8712	89.9714	(217)
Fuel for water heating, kWh/month	167.9912	125.0643	98.6681	50.1545	19.7690	2.9152	0.0000	29.5406	55.5649	103.4326	142.8704	166.8452	(219)
Water heating fuel used												962.8161	(219)
Annual totals kWh/year													
Space heating fuel - main system												4439.0747	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4230.8339	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4439.0747	3.4800	154.4798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.8161	3.4800	33.5060	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			153.5234	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4423	(257)
SAP value	93.8298	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4439.0747	0.2160	958.8401	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.8161	0.2160	207.9683	(264)
Space and water heating			1166.8084	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			559.0299	(272)
CO2 emissions per m2			5.5500	(273)
EI value			94.8614	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2243	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-887.0104	(H17)
Solar input	-27.3017	-41.0345	-69.1072	-95.5273	-115.0470	-121.0820	-118.1746	-105.5306	-82.3670	-56.0328	-33.1860	-22.6197	(63)
								Solar input (sum of months) = Sum(63)m =				-887.0104	(63)
Output from w/h													
	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
								Total per year (kWh/year) = Sum(64)m =				851.2283	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	12.9236	0.4600	0.0000	0.7700	29.1131	(75)
Southwest	5.0200	40.4699	0.4600	0.0000	0.7700	71.9589	(79)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	148.8057	237.0155	344.0420	480.4457	560.7064	612.7102	577.3487	513.0418	418.3571	286.5717	184.4403	124.9696	(83)
Total gains	783.6970	866.7707	948.8415	1046.6335	1087.2291	1104.0139	1048.3393	993.3372	921.1312	828.1847	769.0893	742.3030	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9742	0.9629	0.9356	0.8704	0.7458	0.5320	0.3666	0.3950	0.6769	0.8873	0.9571	0.9776	(86)
MIT	19.3551	19.5402	19.9009	20.3532	20.7289	20.9416	20.9881	20.9848	20.8588	20.4137	19.8343	19.3344	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9683	0.9545	0.9204	0.8387	0.6818	0.4278	0.2374	0.2620	0.5818	0.8523	0.9457	0.9725	(89)
MIT 2	17.7061	17.9761	18.4911	19.1241	19.6071	19.8403	19.8690	19.8733	19.7701	19.2241	18.4129	17.6848	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9929	18.2482	18.7363	19.3379	19.8023	20.0319	20.0637	20.0667	19.9595	19.4310	18.6601	17.9717	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8429	18.0982	18.5863	19.1879	19.6523	19.8819	19.9137	19.9167	19.8095	19.2810	18.5101	17.8217	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9365	0.8981	0.8156	0.6683	0.4285	0.2423	0.2668	0.5756	0.8292	0.9266	0.9590	(94)
Useful gains	747.1714	811.7740	852.1369	853.6471	726.5531	473.0663	254.0597	265.0108	530.1646	686.6961	712.6262	711.8351	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1659.3877	1616.7422	1447.0439	1190.1832	852.4436	491.7198	255.7849	267.3952	583.8875	978.4535	1338.8417	1635.2224	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating												3353.1497	(98)
Space heating per m2											(98) / (4) =	33.2720	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3705.1378	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	749.9325	597.7222	489.0727	267.7414	103.4945	0.0000	0.0000	0.0000	0.0000	239.8536	498.2046	759.1162	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9066	89.9279	89.9358	89.9766	89.8862	87.3000	87.3000	87.3000	87.3000	89.5339	89.7851	89.9139	(217)
Fuel for water heating, kWh/month	165.7778	126.3160	101.6165	50.8014	23.8567	0.0000	0.0000	23.8772	51.4554	101.1444	139.3620	165.2658	(219)
Water heating fuel used												949.4731	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.1378	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3386.6337	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3705.1378	3.9200	145.2414	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	949.4731	3.9200	37.2193	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			55.4118	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3705.1378	0.2160	800.3098	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.4731	0.2160	205.0862	(264)
Space and water heating			1005.3959	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			347.3158 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3705.1378	1.2200	4520.2681	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.4731	1.2200	1158.3571	(264)
Space and water heating			5678.6252	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1785.9356	(272)
Primary energy kWh/m2/year			17.7211	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	343.88	(P1)
Transmission heat loss coefficient	77.96	(37)
Summer heat loss coefficient	421.84	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.3600	98.8453	0.4600	0.0000	0.9000	260.2635
South West	5.0200	119.9223	0.4600	0.0000	0.9000	249.2322
South West	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						674.8231

	Jun	Jul	Aug	
Solar gains	716	675	600	(P4)
Internal gains	488	468	477	
Total summer gains	1204	1143	1077	(P5)
Summer gain/loss ratio	2.86	2.71	2.55	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.74	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-330	**Issued on Date**	19/10/2022
Assessment Reference	Plot 330	**Prop Type Ref**	Maplethorne-As-DET
Property	Plot 330, 3 Bed, K, WC, B, En		

SAP Rating	84 B	**DER**	17.73	**TER**	18.63
Environmental	85 B	**% DER<TER**	4.85		
CO_2 Emissions (t/year)	1.40	**DFEE**	51.20	**TFEE**	57.60
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.12		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.73 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.2 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.06 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 7.64 m², No overhang
Windows facing North West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.4122	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	547.6176	645.8487	736.7382	827.4201	888.1523	874.1383	833.3911	773.8226	706.8911	615.9443	541.2018	515.0665	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9921	0.9855	0.9715	0.9360	0.8603	0.7269	0.5821	0.6345	0.8370	0.9559	0.9867	0.9936	(86)
MIT	19.0213	19.2426	19.6047	20.0875	20.5185	20.8224	20.9400	20.9183	20.6831	20.1217	19.4917	18.9932	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9902	0.9820	0.9640	0.9181	0.8183	0.6418	0.4549	0.5097	0.7723	0.9401	0.9829	0.9920	(89)
MIT 2	17.2030	17.5268	18.0532	18.7526	19.3435	19.7270	19.8397	19.8272	19.5739	18.8139	17.9019	17.1703	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.4796	17.7878	18.2893	18.9557	19.5222	19.8937	20.0071	19.9932	19.7426	19.0128	18.1437	17.4476	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3296	17.6378	18.1393	18.8057	19.3722	19.7437	19.8571	19.8432	19.5926	18.8628	17.9937	17.2976	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9717	0.9483	0.8963	0.7965	0.6309	0.4533	0.5061	0.7531	0.9205	0.9730	0.9863	(94)
Useful gains	538.5522	627.5594	698.6713	741.5996	707.3905	551.4596	377.7767	391.6024	532.3738	566.9558	526.5880	508.0323	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1640.1820	1597.8756	1455.0759	1218.3871	940.7826	621.6978	393.6717	415.0453	667.5856	1013.2039	1344.1212	1626.4897	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	819.6125	652.0525	562.7650	343.2870	173.6437	0.0000	0.0000	0.0000	0.0000	332.0086	588.6239	832.1323	(98)
Space heating												4304.1255	(98)
Space heating per m2											(98) / (4) =	44.9705	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4755.9397	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	819.6125	652.0525	562.7650	343.2870	173.6437	0.0000	0.0000	0.0000	0.0000	332.0086	588.6239	832.1323	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	905.6492	720.5000	621.8398	379.3226	191.8715	0.0000	0.0000	0.0000	0.0000	366.8603	650.4132	919.4832	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9217	89.8742	89.7760	89.5506	89.0719	87.3000	87.3000	87.3000	87.3000	89.5028	89.8084	89.9426	(217)
Fuel for water heating, kWh/month													
	193.9294	170.1397	176.8021	155.9892	151.5702	135.0886	126.8064	143.1997	144.2255	161.9929	174.3294	188.2493	(219)
Water heating fuel used												1922.3225	(219)
Annual totals kWh/year													
Space heating fuel - main system												4755.9397	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7169.3416	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4755.9397	0.2160	1027.2830	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.3225	0.2160	415.2217	(264)
Space and water heating			1442.5046	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/year			1697.3748	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.7300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.7300	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		35.0784	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.0784	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	7.6400	36.7938	0.6300	0.7000	0.7700	85.9093	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	113.9361	200.6956	292.1848	391.5051	465.4209	473.8888	451.9548	395.0012	326.2951	226.5525	137.6748	96.7255	(83)
Total gains	541.8754	626.3173	702.6702	776.9384	825.2575	809.2377	771.9855	722.1307	666.7876	592.3217	531.6957	512.0645	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9984	0.9966	0.9913	0.9731	0.9168	0.7829	0.6177	0.6741	0.8909	0.9830	0.9968	0.9988	(86)
MIT	19.6238	19.7772	20.0331	20.3797	20.6964	20.9094	20.9780	20.9667	20.8121	20.4040	19.9549	19.6026	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9979	0.9954	0.9880	0.9619	0.8800	0.6925	0.4822	0.5401	0.8287	0.9740	0.9955	0.9984	(89)
MIT 2	18.0649	18.2910	18.6656	19.1735	19.6083	19.8673	19.9228	19.9190	19.7669	19.2156	18.5609	18.0419	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.3021	18.5171	18.8736	19.3570	19.7738	20.0259	20.0833	20.0784	19.9259	19.3964	18.7730	18.2793	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3021	18.5171	18.8736	19.3570	19.7738	20.0259	20.0833	20.0784	19.9259	19.3964	18.7730	18.2793	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9930	0.9836	0.9541	0.8740	0.7015	0.5026	0.5598	0.8286	0.9677	0.9932	0.9974	(94)
Useful gains	540.0564	621.9495	691.1195	741.2844	721.2339	567.6970	387.9973	404.2737	552.5244	573.1913	528.1042	510.7503	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1646.3431	1596.2378	1446.1712	1205.0655	927.9554	615.8886	395.3902	416.5610	664.4887	1011.0026	1348.8427	1636.0185	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	823.0773	654.7217	561.7584	333.9223	153.8008	0.0000	0.0000	0.0000	0.0000	325.7316	590.9317	837.1996	(98)
Space heating												4281.1435	(98)
Space heating per m2											(98) / (4) =	44.7304	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4583.6654	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	823.0773	654.7217	561.7584	333.9223	153.8008	0.0000	0.0000	0.0000	0.0000	325.7316	590.9317	837.1996	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	881.2391	700.9868	601.4544	357.5186	164.6689	0.0000	0.0000	0.0000	0.0000	348.7491	632.6892	896.3593	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1363	87.9508	87.5560	86.6717	84.8292	80.3000	80.3000	80.3000	80.3000	86.5017	87.6928	88.2079	(217)
Fuel for water heating, kWh/month													
	239.6317	211.6837	223.3784	200.2496	198.0880	184.3053	176.5785	196.8436	199.0176	210.2576	219.1990	233.7049	(219)
Water heating fuel used												2492.9379	(219)
Annual totals kWh/year													
Space heating fuel - main system												4583.6654	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7567.6827	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4583.6654	0.2160	990.0717	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2492.9379	0.2160	538.4746	(264)
Space and water heating			1528.5463	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1783.4165	(272)
Emissions per m2 for space and water heating			15.9706	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9706 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.6300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3718	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3718	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4740	0.4647	0.4554	0.4089	0.3996	0.3532	0.3532	0.3439	0.3718	0.3996	0.4182	0.4368	(22b)
Effective ac	0.6123	0.6080	0.6037	0.5836	0.5799	0.5624	0.5624	0.5591	0.5691	0.5799	0.5875	0.5954	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9941	49.6379	49.2889	47.6492	47.3424	45.9144	45.9144	45.6499	46.4644	47.3424	47.9630	48.6118	(38)
Heat transfer coeff	123.7787	123.4226	123.0735	121.4339	121.1271	119.6990	119.6990	119.4345	120.2491	121.1271	121.7477	122.3965	(39)
Average = Sum(39)m / 12 =												121.4324	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2933	1.2895	1.2859	1.2688	1.2656	1.2506	1.2506	1.2479	1.2564	1.2656	1.2720	1.2788	(40)
HLP (average)												1.2688	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	514.0202	613.0743	705.6729	798.6823	860.9265	849.0393	810.0964	748.2124	680.4557	587.1005	509.6425	482.2886	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2409	36.3455	36.4486	36.9407	37.0343	37.4761	37.4761	37.5591	37.3047	37.0343	36.8455	36.6502	
alpha	3.4161	3.4230	3.4299	3.4627	3.4690	3.4984	3.4984	3.5039	3.4870	3.4690	3.4564	3.4433	
util living area													
	0.9935	0.9876	0.9745	0.9408	0.8673	0.7361	0.5912	0.6463	0.8471	0.9609	0.9889	0.9948	(86)
MIT	19.0143	19.2357	19.5981	20.0787	20.5123	20.8182	20.9385	20.9151	20.6740	20.1067	19.4763	18.9818	(87)
Th 2	19.8461	19.8490	19.8519	19.8654	19.8679	19.8797	19.8797	19.8819	19.8752	19.8679	19.8628	19.8575	(88)
util rest of house													
	0.9919	0.9845	0.9678	0.9241	0.8268	0.6522	0.4640	0.5219	0.7850	0.9467	0.9856	0.9935	(89)
MIT 2	18.0415	18.2637	18.6246	19.1037	19.5115	19.7789	19.8582	19.8491	19.6688	19.1400	18.5145	18.0175	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1895	18.4116	18.7727	19.2520	19.6638	19.9370	20.0225	20.0113	19.8217	19.2871	18.6608	18.1641	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1895	18.4116	18.7727	19.2520	19.6638	19.9370	20.0225	20.0113	19.8217	19.2871	18.6608	18.1641	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9792	0.9594	0.9126	0.8182	0.6570	0.4816	0.5378	0.7814	0.9370	0.9807	0.9908	(94)
Useful gains	508.1643	600.3069	677.0465	728.9136	704.3746	557.8358	390.1185	402.3815	531.7189	550.0839	499.8282	477.8335	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1719.2263	1667.6337	1510.4395	1257.0870	964.6267	638.8292	409.6733	431.3134	688.0328	1052.2394	1407.4965	1709.1625	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	901.0301	717.2436	620.0444	380.2849	193.6276	0.0000	0.0000	0.0000	0.0000	373.6037	653.5212	916.1088	(98)
Space heating												4755.4642	(98)
Space heating per m2											(98) / (4) =	49.6862	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1125.1706	885.7726	907.7025	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7672	0.8380	0.8059	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	863.2469	742.2894	731.4885	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1095.5554	1047.8872	977.5367	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	167.2621	227.3648	183.0599	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												577.6868	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	41.8155	56.8412	45.7650	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												144.4217	(107)
Space cooling per m2												1.5090	(108)
Energy for space heating												49.6862	(99)
Energy for space cooling												1.5090	(108)
Total												51.1951	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3713	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	7.6400	36.7938	0.6300	0.7000	0.7700	85.9093	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	113.9361	200.6956	292.1848	391.5051	465.4209	473.8888	451.9548	395.0012	326.2951	226.5525	137.6748	96.7255	(83)
Total gains	495.9064	581.1673	659.2207	736.4400	786.9329	773.6994	738.2437	685.4143	628.5807	551.0827	487.7546	466.9110	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9989	0.9975	0.9933	0.9781	0.9285	0.8034	0.6408	0.7010	0.9085	0.9873	0.9978	0.9992	(86)
MIT	19.5796	19.7342	19.9927	20.3450	20.6711	20.8978	20.9743	20.9605	20.7897	20.3668	19.9128	19.5591	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9986	0.9966	0.9908	0.9687	0.8953	0.7154	0.5026	0.5658	0.8523	0.9803	0.9969	0.9989	(89)
MIT 2	18.6022	18.7587	19.0184	19.3763	19.6858	19.8809	19.9243	19.9214	19.8012	19.4032	18.9484	18.5907	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.7509	18.9071	19.1666	19.5237	19.8357	20.0356	20.0841	20.0795	19.9516	19.5498	19.0951	18.7380	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7509	18.9071	19.1666	19.5237	19.8357	20.0356	20.0841	20.0795	19.9516	19.5498	19.0951	18.7380	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9955	0.9884	0.9642	0.8921	0.7252	0.5237	0.5861	0.8540	0.9770	0.9958	0.9985	(94)
Useful gains	494.9166	578.5395	651.5698	710.0836	702.0581	561.1144	386.6507	401.7298	536.7805	538.3953	485.7226	466.2178	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1699.1117	1641.9584	1480.4082	1224.2713	935.0719	616.9945	395.4748	416.6864	667.4192	1028.6335	1386.0686	1689.3129	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	895.9212	714.6175	616.6558	370.2151	173.3623	0.0000	0.0000	0.0000	0.0000	364.7372	648.2491	909.9828	(98)
Space heating												4693.7409	(98)
Space heating per m2											(98) / (4) =	49.0413	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8059	0.8823	0.8507	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	859.9201	741.1018	732.1416	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.4958	963.9035	904.1363	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	106.2545	165.7645	127.9641	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												399.9830 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	26.5636	41.4411	31.9910	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												99.9958 (107)
Space cooling per m2												1.0448 (108)
Energy for space heating												49.0413 (99)
Energy for space cooling												1.0448 (108)
Total												50.0861 (109)
Target Fabric Energy Efficiency (TFEE)												57.6 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4122	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Energy content (annual)                                                                          Total = Sum(45)m =    1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =    1711.1415 (64)
RHI water heating demand                                                                                                      1711 (64)
Heat gains from water heating, kWh/month
               56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
               76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
              618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)
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6. Solar gains

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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2             Table 6a       Specific data    Specific data       factor                W
                                                           W/m2          or Table 6b      or Table 6c      Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
Northeast                              5.0600            12.9236            0.4600           0.0000           0.7700           23.1623 (75)
Southeast                              0.7200            40.4699            0.4600           0.0000           0.7700           10.3208 (77)
Southwest                              4.3100            40.4699            0.4600           0.0000           0.7700           61.7815 (79)
Northwest                              0.7200            12.9236            0.4600           0.0000           0.7700            3.2958 (81)
Southwest                              3.3300            40.4699            0.4600           0.0000           0.7700           47.7337 (79)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    146.2940   232.3466   335.6072   466.0678   541.8675   591.2343   557.4671   496.8249   407.1726   280.4399   181.1879   122.9477 (83)
Total gains    764.2955   845.3488   924.3932  1017.3910  1054.7510  1069.9332  1016.4065   964.8817   896.9984   807.9528   750.4708   723.9115 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                    21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           36.6931    36.9077    36.9077    37.2143    37.2143    37.5928    37.5015    37.6817    37.5928    37.4080    37.4080    37.1142
alpha          3.4462     3.4605     3.4605     3.4810     3.4810     3.5062     3.5001     3.5121     3.5062     3.4939     3.4939     3.4743
util living area
                0.9753     0.9639     0.9362     0.8694     0.7408     0.5233     0.3580     0.3855     0.6686     0.8860     0.9581     0.9788 (86)

MIT            19.4652    19.6441    19.9897    20.4167    20.7647    20.9527    20.9910    20.9884    20.8808    20.4701    19.9181    19.4409 (87)
Th 2           19.8586    19.8645    19.8645    19.8727    19.8727    19.8828    19.8804    19.8851    19.8828    19.8779    19.8779    19.8701 (88)
util rest of house
                0.9695     0.9555     0.9207     0.8367     0.6755     0.4197     0.2320     0.2556     0.5723     0.8498     0.9466     0.9737 (89)
MIT 2          17.8641    18.1245    18.6170    19.2118    19.6542    19.8558    19.8783    19.8821    19.7969    19.3005    18.5308    17.8366 (90)
Living area fraction                                                                                    fLA = Living area / (4) =       0.1521 (91)
MIT            18.1077    18.3557    18.8258    19.3951    19.8232    20.0226    20.0475    20.0504    19.9618    19.4784    18.7419    18.0807 (92)
Temperature adjustment                                                                                                          -0.1500
adjusted MIT   17.9577    18.2057    18.6758    19.2451    19.6732    19.8726    19.8975    19.9004    19.8118    19.3284    18.5919    17.9307 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9554     0.9384     0.8993     0.8146     0.6624     0.4187     0.2340     0.2575     0.5654     0.8275     0.9282     0.9609 (94)
Useful gains  730.1939   793.2784   831.3032   828.7839   698.6515   447.9614   237.7896   248.4299   507.1859   668.5872   696.5619   695.6202 (95)
Ext temp.       5.1000     5.6000     7.4000     9.9000    13.0000    16.0000    17.9000    17.8000    15.2000    11.6000     8.0000     5.1000 (96)
Heat loss rate W
             1571.8940  1532.1244  1370.4950  1126.4712   804.3932   462.1119   238.9424   250.0482   550.3091   926.7709  1270.1457  1550.7979 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              626.2249   496.5045   401.1588   214.3348    78.6718     0.0000     0.0000     0.0000     0.0000   192.0887   412.9803   636.2522 (98)
Space heating                                                                                                                3058.2160 (98)
RHI space heating demand                                                                                                        3058 (98)
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CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.4122	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004	(36)
Total fabric heat loss	(33) + (36) =	73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	750.0514	845.6048	927.4230	1005.0707	1052.2981	1027.9275	982.7469	925.8560	867.9959	790.0833	728.8456	713.0669	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9799	0.9688	0.9469	0.8976	0.8048	0.6562	0.5097	0.5541	0.7623	0.9167	0.9686	0.9829	(86)
MIT	19.2647	19.4747	19.8113	20.2507	20.6245	20.8727	20.9603	20.9466	20.7729	20.2950	19.7113	19.2342	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9753	0.9616	0.9343	0.8722	0.7546	0.5690	0.3918	0.4360	0.6867	0.8906	0.9601	0.9790	(89)
MIT 2	17.5549	17.8598	18.3443	18.9715	19.4696	19.7721	19.8510	19.8447	19.6679	19.0474	18.2159	17.5196	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8150	18.1055	18.5675	19.1661	19.6453	19.9395	20.0197	20.0123	19.8360	19.2372	18.4434	17.7804	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6650	17.9555	18.4175	19.0161	19.4953	19.7895	19.8697	19.8623	19.6860	19.0872	18.2934	17.6304	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9627	0.9453	0.9136	0.8489	0.7361	0.5622	0.3918	0.4349	0.6728	0.8677	0.9437	0.9676	(94)
Useful gains	722.0446	799.3780	847.3109	853.2499	774.6364	577.8754	385.0515	402.6253	584.0035	685.5416	687.8335	689.9696	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1682.4069	1637.7265	1489.8623	1244.2685	955.8690	627.2375	395.1985	417.3518	678.9390	1040.7184	1381.0926	1667.8202	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	714.5095	563.3702	478.0582	281.5334	134.8371	0.0000	0.0000	0.0000	0.0000	264.2516	499.1465	727.5208	(98)
Space heating												3663.2274	(98)
Space heating per m2											(98) / (4) =	38.2742	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4047.7651	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	714.5095	563.3702	478.0582	281.5334	134.8371	0.0000	0.0000	0.0000	0.0000	264.2516	499.1465	727.5208	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	789.5133	622.5085	528.2412	311.0866	148.9913	0.0000	0.0000	0.0000	0.0000	291.9907	551.5431	803.8904	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8539	89.7973	89.6806	89.4131	88.8702	87.3000	87.3000	87.3000	87.3000	89.3398	89.7148	89.8780	(217)
Fuel for water heating, kWh/month													
	194.0759	170.2853	176.9902	156.2291	151.9142	135.0886	126.8064	143.1997	144.2255	162.2885	174.5112	188.3846	(219)
Water heating fuel used												1923.9993	(219)
Annual totals kWh/year													
Space heating fuel - main system												4047.7651	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												6462.8437	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4047.7651	3.4800	140.8622	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1923.9993	3.4800	66.9552	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Total energy cost			392.5908	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1718	(257)
SAP value		83.6530	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4047.7651	0.2160	874.3173	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1923.9993	0.2160	415.5838	(264)
Space and water heating			1289.9011	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1544.7713	(272)
CO2 emissions per m2			16.1400	(273)
EI value			85.2889	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(75)
Southeast	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(77)
Southwest	4.3100	40.4699	0.4600	0.0000	0.7700	61.7815	(79)
Northwest	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(81)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	146.2940	232.3466	335.6072	466.0678	541.8675	591.2343	557.4671	496.8249	407.1726	280.4399	181.1879	122.9477	(83)
Total gains	764.2955	845.3488	924.3932	1017.3910	1054.7510	1069.9332	1016.4065	964.8817	896.9984	807.9528	750.4708	723.9115	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6931	36.9077	36.9077	37.2143	37.2143	37.5928	37.5015	37.6817	37.5928	37.4080	37.4080	37.1142	
alpha	3.4462	3.4605	3.4605	3.4810	3.4810	3.5062	3.5001	3.5121	3.5062	3.4939	3.4939	3.4743	
util living area													
	0.9753	0.9639	0.9362	0.8694	0.7408	0.5233	0.3580	0.3855	0.6686	0.8860	0.9581	0.9788	(86)
MIT	19.4652	19.6441	19.9897	20.4167	20.7647	20.9527	20.9910	20.9884	20.8808	20.4701	19.9181	19.4409	(87)
Th 2	19.8586	19.8645	19.8645	19.8727	19.8727	19.8828	19.8804	19.8851	19.8828	19.8779	19.8779	19.8701	(88)
util rest of house													
	0.9695	0.9555	0.9207	0.8367	0.6755	0.4197	0.2320	0.2556	0.5723	0.8498	0.9466	0.9737	(89)
MIT 2	17.8641	18.1245	18.6170	19.2118	19.6542	19.8558	19.8783	19.8821	19.7969	19.3005	18.5308	17.8366	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1077	18.3557	18.8258	19.3951	19.8232	20.0226	20.0475	20.0504	19.9618	19.4784	18.7419	18.0807	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9577	18.2057	18.6758	19.2451	19.6732	19.8726	19.8975	19.9004	19.8118	19.3284	18.5919	17.9307	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9554	0.9384	0.8993	0.8146	0.6624	0.4187	0.2340	0.2575	0.5654	0.8275	0.9282	0.9609	(94)
Useful gains	730.1939	793.2784	831.3032	828.7839	698.6515	447.9614	237.7896	248.4299	507.1859	668.5872	696.5619	695.6202	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1571.8940	1532.1244	1370.4950	1126.4712	804.3932	462.1119	238.9424	250.0482	550.3091	926.7709	1270.1457	1550.7979	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	626.2249	496.5045	401.1588	214.3348	78.6718	0.0000	0.0000	0.0000	0.0000	192.0887	412.9803	636.2522	(98)
Space heating												3058.2160	(98)
Space heating per m2											(98) / (4) =	31.9529	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3379.2442	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	626.2249	496.5045	401.1588	214.3348	78.6718	0.0000	0.0000	0.0000	0.0000	192.0887	412.9803	636.2522	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	691.9612	548.6238	443.2694	236.8341	86.9301	0.0000	0.0000	0.0000	0.0000	212.2527	456.3318	703.0411	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7832	89.7256	89.5692	89.2097	88.4515	87.3000	87.3000	87.3000	87.3000	89.0953	89.5972	89.8081	(217)
Fuel for water heating, kWh/month													
	194.2287	170.4215	177.2103	156.5853	152.6333	135.0886	126.8064	143.1997	144.2255	162.7339	174.7403	188.5313	(219)
Water heating fuel used												1926.4047	(219)
Annual totals kWh/year													
Space heating fuel - main system												3379.2442	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												5796.7283	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3379.2442	3.9200	132.4664	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1926.4047	3.9200	75.5151	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Total energy cost			379.2685	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3379.2442	0.2160	729.9168	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.4047	0.2160	416.1034	(264)
Space and water heating			1146.0202	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1400.8904	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3379.2442	1.2200	4122.6779	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.4047	1.2200	2350.2138	(264)
Space and water heating			6472.8917	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Primary energy kWh/year			7980.5054	(272)
Primary energy kWh/m2/year			83.3821	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 30	-188 kg (13.4%)
U Solar photovoltaic panels	+ 9.5	-£ 309	-947 kg (78.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.97 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.89 kg/m²	A 94	A 96
Total Savings	£340	11.86 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£83	£92	-£8
Mains gas	£296	£257	£39
Space heating	£233	£233	£0
Water heating	£76	£45	£30
Lighting	£71	£71	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£379	£40	£340
Total cost of uses	£380	£40	£339
Delivered energy	61 kWh/m²	32 kWh/m²	29 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	83 kWh/m²	14 kWh/m²	70 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1734	(H8)
Utilisation factor												0.5735	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-865.2421	(H17)
Solar input	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963	(63)
											Solar input (sum of months) = Sum(63)m =	-865.2421	(63)
Output from w/h													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
											Total per year (kWh/year) = Sum(64)m =	849.7380	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	750.0514	845.6048	927.4230	1005.0707	1052.2981	1027.9275	982.7469	925.8560	867.9959	790.0833	728.8456	713.0669	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9799	0.9688	0.9469	0.8976	0.8048	0.6562	0.5097	0.5541	0.7623	0.9167	0.9686	0.9829	(86)
MIT	19.2647	19.4747	19.8113	20.2507	20.6245	20.8727	20.9603	20.9466	20.7729	20.2950	19.7113	19.2342	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9753	0.9616	0.9343	0.8722	0.7546	0.5690	0.3918	0.4360	0.6867	0.8906	0.9601	0.9790	(89)
MIT 2	17.5549	17.8598	18.3443	18.9715	19.4696	19.7721	19.8510	19.8447	19.6679	19.0474	18.2159	17.5196	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8150	18.1055	18.5675	19.1661	19.6453	19.9395	20.0197	20.0123	19.8360	19.2372	18.4434	17.7804	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6650	17.9555	18.4175	19.0161	19.4953	19.7895	19.8697	19.8623	19.6860	19.0872	18.2934	17.6304	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9627	0.9453	0.9136	0.8489	0.7361	0.5622	0.3918	0.4349	0.6728	0.8677	0.9437	0.9676	(94)
Useful gains	722.0446	799.3780	847.3109	853.2499	774.6364	577.8754	385.0515	402.6253	584.0035	685.5416	687.8335	689.9696	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1682.4069	1637.7265	1489.8623	1244.2685	955.8690	627.2375	395.1985	417.3518	678.9390	1040.7184	1381.0926	1667.8202	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	714.5095	563.3702	478.0582	281.5334	134.8371	0.0000	0.0000	0.0000	0.0000	264.2516	499.1465	727.5208	(98)
Space heating												3663.2274	(98)
Space heating per m2											(98) / (4) =	38.2742	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4047.7651	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	714.5095	563.3702	478.0582	281.5334	134.8371	0.0000	0.0000	0.0000	0.0000	264.2516	499.1465	727.5208	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	789.5133	622.5085	528.2412	311.0866	148.9913	0.0000	0.0000	0.0000	0.0000	291.9907	551.5431	803.8904	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9303	89.9571	89.9901	90.0528	90.1312	87.3000	87.3000	87.3000	87.3000	89.6550	89.8330	89.9417	(217)
Fuel for water heating, kWh/month													
	166.0113	123.4402	97.1431	48.9981	18.7989	2.1281	0.0000	28.5666	54.4449	102.0187	141.1527	164.9069	(219)
Water heating fuel used												947.6095	(219)
Annual totals kWh/year													
Space heating fuel - main system												4047.7651	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3809.2146	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4047.7651	3.4800	140.8622	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.6095	3.4800	32.9768	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			137.3845	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4101	(257)
SAP value	94.2795	
SAP rating (Section 12)	94	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4047.7651	0.2160	874.3173	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.6095	0.2160	204.6837	(264)
Space and water heating			1079.0009	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			463.3839	(272)
CO2 emissions per m2			4.8400	(273)
EI value			95.5871	
EI rating			96	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                          Total = Sum(45)m =   1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
             174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.2393 (H8)
Utilisation factor                                                                                                                  0.5538 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             98.2325 (H14)
Volume ratio Veff/V                                                                                                                 0.7635 (H15)
Solar storage volume factor                                                                                                         0.9460 (H16)
Solar input                                                                                                                      -882.3194 (H17)
Solar input    -27.1574   -40.8174   -68.7417   -95.0221  -114.4386  -120.4417  -117.5496  -104.9725   -81.9314   -55.7364   -33.0105   -22.5000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -882.3194 (63)
Output from w/h
             147.2273   112.0942    89.9842    44.6672    20.5678     0.0000     0.0000    20.0408    43.9775    89.2518   123.5519   146.8163 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    838.1790 (64)
Heat gains from water heating, kWh/month
              56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
              76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
             618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area        Solar flux          g              FF          Access          Gains
                                          m2          Table 6a    Specific data  Specific data    factor              W
                                                         W/m2    or Table 6b    or Table 6c    Table 6d
-------------------------------------------------------------------------------------------------------------
Northeast                               5.0600          12.9236         0.4600         0.0000         0.7700         23.1623 (75)
Southeast                               0.7200          40.4699         0.4600         0.0000         0.7700         10.3208 (77)
Southwest                               4.3100          40.4699         0.4600         0.0000         0.7700         61.7815 (79)
Northwest                               0.7200          12.9236         0.4600         0.0000         0.7700          3.2958 (81)
Southwest                               3.3300          40.4699         0.4600         0.0000         0.7700         47.7337 (79)
-------------------------------------------------------------------------------------------------------------

Solar gains    146.2940   232.3466   335.6072   466.0678   541.8675   591.2343   557.4671   496.8249   407.1726   280.4399   181.1879   122.9477 (83)
Total gains    764.2955   845.3488   924.3932  1017.3910  1054.7510  1069.9332  1016.4065   964.8817   896.9984   807.9528   750.4708   723.9115 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           36.6931    36.9077    36.9077    37.2143    37.2143    37.5928    37.5015    37.6817    37.5928    37.4080    37.4080    37.1142
alpha          3.4462     3.4605     3.4605     3.4810     3.4810     3.5062     3.5001     3.5121     3.5062     3.4939     3.4939     3.4743
util living area
               0.9753     0.9639     0.9362     0.8694     0.7408     0.5233     0.3580     0.3855     0.6686     0.8860     0.9581     0.9788 (86)

MIT           19.4652    19.6441    19.9897    20.4167    20.7647    20.9527    20.9910    20.9884    20.8808    20.4701    19.9181    19.4409 (87)
Th 2          19.8586    19.8645    19.8645    19.8727    19.8727    19.8828    19.8804    19.8851    19.8828    19.8779    19.8779    19.8701 (88)
util rest of house
               0.9695     0.9555     0.9207     0.8367     0.6755     0.4197     0.2320     0.2556     0.5723     0.8498     0.9466     0.9737 (89)
MIT 2         17.8641    18.1245    18.6170    19.2118    19.6542    19.8558    19.8783    19.8821    19.7969    19.3005    18.5308    17.8366 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1521 (91)
MIT           18.1077    18.3557    18.8258    19.3951    19.8232    20.0226    20.0475    20.0504    19.9618    19.4784    18.7419    18.0807 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.9577    18.2057    18.6758    19.2451    19.6732    19.8726    19.8975    19.9004    19.8118    19.3284    18.5919    17.9307 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9554	0.9384	0.8993	0.8146	0.6624	0.4187	0.2340	0.2575	0.5654	0.8275	0.9282	0.9609	(94)
Useful gains	730.1939	793.2784	831.3032	828.7839	698.6515	447.9614	237.7896	248.4299	507.1859	668.5872	696.5619	695.6202	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1571.8940	1532.1244	1370.4950	1126.4712	804.3932	462.1119	238.9424	250.0482	550.3091	926.7709	1270.1457	1550.7979	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	626.2249	496.5045	401.1588	214.3348	78.6718	0.0000	0.0000	0.0000	0.0000	192.0887	412.9803	636.2522	(98)

Space heating 3058.2160 (98)
Space heating per m2 (98) / (4) = 31.9529 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3379.2442 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	626.2249	496.5045	401.1588	214.3348	78.6718	0.0000	0.0000	0.0000	0.0000	192.0887	412.9803	636.2522	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	691.9612	548.6238	443.2694	236.8341	86.9301	0.0000	0.0000	0.0000	0.0000	212.2527	456.3318	703.0411	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	147.2273	112.0942	89.9842	44.6672	20.5678	0.0000	0.0000	20.0408	43.9775	89.2518	123.5519	146.8163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8729	89.8931	89.8963	89.9315	89.8177	87.3000	87.3000	87.3000	87.3000	89.4597	89.7425	89.8823	(217)
Fuel for water heating, kWh/month	163.8172	124.6972	100.0978	49.6680	22.8995	0.0000	0.0000	22.9562	50.3751	99.7675	137.6738	163.3429	(219)

Water heating fuel used 935.2954 (219)
Annual totals kWh/year
Space heating fuel - main system 3379.2442 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596 -1824.1596 (233)
Total delivered energy for all uses 3031.4593 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3379.2442	3.9200	132.4664	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	935.2954	3.9200	36.6636	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			39.5195	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3379.2442	0.2160	729.9168	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.2954	0.2160	202.0238	(264)
Space and water heating			931.9406	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1824.1596		0.5190	-946.7389 (269)
Total kg/year				266.0219 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3379.2442	1.2200	4122.6779	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.2954	1.2200	1141.0604	(264)
Space and water heating			5263.7383	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1324.6819	(272)
Primary energy kWh/m2/year			13.8406	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	326.58 (P1)
Transmission heat loss coefficient	73.78 (37)
Summer heat loss coefficient	400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
South West	4.3100	119.9223	0.4600	0.0000	0.9000	213.9822
North West	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
South West	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						651.5849

	Jun	Jul	Aug	
Solar gains	691	652	581	(P4)
Internal gains	476	456	465	
Total summer gains	1167	1108	1046	(P5)
Summer gain/loss ratio	2.91	2.77	2.61	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.73	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-331	**Issued on Date**	19/10/2022
Assessment Reference	Plot 331	**Prop Type Ref**	Islington-As-DET
Property	Plot 331, 3 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.83	**TER**	18.80
Environmental	85 B	**% DER<TER**	5.14		
CO_2 Emissions (t/year)	1.48	**DFEE**	52.66	**TFEE**	59.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.86		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.83 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.7 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 6.36 m², No overhang
Windows facing South West: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	560.6773	661.1806	755.3521	850.7274	915.4613	902.0110	859.5809	796.3376	725.2740	630.5153	553.8114	527.3462	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9913	0.9846	0.9704	0.9352	0.8614	0.7319	0.5909	0.6431	0.8402	0.9552	0.9858	0.9929	(86)
MIT	18.8928	19.1201	19.4973	20.0067	20.4637	20.7947	20.9271	20.9022	20.6429	20.0488	19.3905	18.8685	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9893	0.9809	0.9629	0.9176	0.8205	0.6483	0.4634	0.5190	0.7775	0.9396	0.9818	0.9912	(89)
MIT 2	17.0160	17.3489	17.8978	18.6374	19.2673	19.6911	19.8218	19.8067	19.5206	18.7105	17.7563	16.9898	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3424	17.6570	18.1760	18.8756	19.4754	19.8831	20.0141	19.9972	19.7158	18.9433	18.0405	17.3166	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1924	17.5070	18.0260	18.7256	19.3254	19.7331	19.8641	19.8472	19.5658	18.7933	17.8905	17.1666	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9819	0.9699	0.9464	0.8949	0.7978	0.6376	0.4639	0.5170	0.7578	0.9193	0.9713	0.9850	(94)
Useful gains	550.5504	641.2722	714.8403	761.2836	730.3556	575.1029	398.7567	411.6945	549.6350	579.6317	537.9173	519.4283	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1735.6072	1690.4851	1539.5321	1288.3775	996.3905	659.7921	419.5561	441.7381	707.0436	1070.5971	1419.9628	1718.8597	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	881.6823	705.0711	613.5708	379.5076	197.9299	0.0000	0.0000	0.0000	0.0000	365.2782	635.0728	892.3769	(98)
Space heating												4670.4896	(98)
Space heating per m2											(98) / (4) =	46.3434	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5160.7619	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	881.6823	705.0711	613.5708	379.5076	197.9299	0.0000	0.0000	0.0000	0.0000	365.2782	635.0728	892.3769	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	974.2345	779.0840	677.9787	419.3454	218.7071	0.0000	0.0000	0.0000	0.0000	403.6224	701.7379	986.0518	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9504	89.9072	89.8174	89.6091	89.1660	87.3000	87.3000	87.3000	87.3000	89.5598	89.8429	89.9691	(217)
Fuel for water heating, kWh/month													
	196.0489	171.9859	178.6924	157.6142	153.0750	136.5557	128.1658	144.7599	145.8047	163.6797	176.2102	190.3060	(219)
Water heating fuel used												1942.8983	(219)
Annual totals kWh/year													
Space heating fuel - main system												5160.7619	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												7609.8428	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5160.7619	0.2160	1114.7246	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.8983	0.2160	419.6660	(264)
Space and water heating			1534.3906	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/year			1797.0994	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.8300	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		34.8105	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.8105	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625	(83)
Total gains	554.6334	641.0309	720.1582	798.5811	850.2411	834.6064	795.8466	742.8409	683.9939	606.1341	543.9251	524.0983	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9986	0.9970	0.9923	0.9759	0.9242	0.7966	0.6339	0.6911	0.9013	0.9851	0.9972	0.9990	(86)
MIT	19.5814	19.7340	19.9922	20.3470	20.6730	20.8992	20.9746	20.9618	20.7947	20.3750	19.9209	19.5641	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9981	0.9959	0.9894	0.9657	0.8895	0.7071	0.4953	0.5551	0.8421	0.9770	0.9960	0.9986	(89)
MIT 2	17.9911	18.2165	18.5950	19.1175	19.5683	19.8481	19.9102	19.9059	19.7376	19.1650	18.5015	17.9751	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2677	18.4805	18.8381	19.3314	19.7604	20.0310	20.0954	20.0895	19.9215	19.3755	18.7484	18.2515	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9938	0.9853	0.9585	0.8838	0.7175	0.5193	0.5781	0.8426	0.9713	0.9940	0.9977	(94)
Useful gains	552.9672	637.0497	709.5866	765.4202	751.4169	598.8320	413.2815	429.4638	576.3338	588.7382	540.6688	522.8967	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1759.7186	1704.9358	1543.6154	1283.8461	988.9717	656.7301	422.6712	444.9405	707.9237	1076.7071	1438.1713	1746.1794	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating												4705.3404	(98)
Space heating per m2											(98) / (4) =	46.6892	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5037.8377	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	897.8230	717.6194	620.5174	373.2667	176.7408	0.0000	0.0000	0.0000	0.0000	363.0489	646.2018	910.1224	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	961.2666	768.3292	664.3655	399.6431	189.2299	0.0000	0.0000	0.0000	0.0000	388.7033	691.8649	974.4351	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2698	88.1007	87.7372	86.9019	85.1478	80.3000	80.3000	80.3000	80.3000	86.7375	87.8490	88.3328	(217)
Fuel for water heating, kWh/month													
	241.4868	213.2667	224.9306	202.1588	199.7575	186.5567	178.7355	199.2482	201.4487	211.5298	220.7962	235.5205	(219)
Water heating fuel used												2515.4359	(219)
Annual totals kWh/year													
Space heating fuel - main system												5037.8377	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8059.4561	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5037.8377	0.2160	1088.1729	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.4359	0.2160	543.3341	(264)
Space and water heating			1631.5071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1894.2158	(272)
Emissions per m2 for space and water heating			16.1888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1888 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4040	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4040	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5152	0.5051	0.4950	0.4444	0.4343	0.3838	0.3838	0.3737	0.4040	0.4343	0.4545	0.4747	(22b)
Effective ac	0.6327	0.6275	0.6225	0.5988	0.5943	0.5737	0.5737	0.5698	0.5816	0.5943	0.6033	0.6127	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3927	53.9497	53.5155	51.4761	51.0946	49.3183	49.3183	48.9894	50.0025	51.0946	51.8665	52.6735	(38)
Heat transfer coeff	132.3518	131.9088	131.4746	129.4352	129.0536	127.2774	127.2774	126.9484	127.9615	129.0536	129.8255	130.6325	(39)
Average = Sum(39)m / 12 =												129.4334	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3133	1.3089	1.3046	1.2843	1.2805	1.2629	1.2629	1.2597	1.2697	1.2805	1.2882	1.2962	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	526.7625	628.0989	724.0004	821.7304	887.9950	876.6975	836.0939	770.5068	698.6077	601.4122	521.9596	494.2610	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7887	33.9022	34.0142	34.5501	34.6523	35.1359	35.1359	35.2269	34.9480	34.6523	34.4462	34.2334	
alpha	3.2526	3.2601	3.2676	3.3033	3.3102	3.3424	3.3424	3.3485	3.3299	3.3102	3.2964	3.2822	
util living area													
	0.9928	0.9867	0.9734	0.9398	0.8680	0.7407	0.5995	0.6544	0.8498	0.9600	0.9880	0.9942	(86)
MIT	18.8876	19.1150	19.4923	19.9990	20.4581	20.7905	20.9255	20.8988	20.6339	20.0348	19.3764	18.8587	(87)
Th 2	19.8305	19.8339	19.8373	19.8531	19.8561	19.8700	19.8700	19.8726	19.8646	19.8561	19.8501	19.8438	(88)
util rest of house													
	0.9911	0.9835	0.9666	0.9233	0.8285	0.6582	0.4723	0.5307	0.7895	0.9460	0.9846	0.9928	(89)
MIT 2	17.9107	18.1392	18.5153	19.0222	19.4562	19.7513	19.8429	19.8321	19.6291	19.0665	18.4123	17.8915	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0806	18.3089	18.6852	19.1921	19.6305	19.9320	20.0313	20.0177	19.8039	19.2350	18.5800	18.0597	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0806	18.3089	18.6852	19.1921	19.6305	19.9320	20.0313	20.0177	19.8039	19.2350	18.5800	18.0597	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9874	0.9777	0.9577	0.9112	0.8193	0.6634	0.4921	0.5485	0.7856	0.9357	0.9793	0.9897	(94)
Useful gains	520.1339	614.0729	693.3552	748.7858	727.4951	581.5721	411.4112	422.5876	548.8193	562.7647	511.1663	489.1737	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1823.8857	1768.7518	1602.0473	1332.1556	1023.4601	678.6474	436.7210	459.2552	729.8811	1114.3720	1490.4019	1810.5297	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	969.9913	775.9442	676.0669	420.0262	220.1980	0.0000	0.0000	0.0000	0.0000	410.3959	705.0496	983.0889	(98)
Space heating												5160.7610	(98)
Space heating per m2											(98) / (4) =	51.2082	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1196.4072	941.8525	964.8080	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7476	0.8197	0.7861	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	894.3903	772.0217	758.4036	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1130.8406	1081.1498	1006.5616	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	170.2442	229.9913	184.6296	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												584.8650	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.5610	57.4978	46.1574	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												146.2162	(107)
Space cooling per m2												1.4508	(108)
Energy for space heating												51.2082	(99)
Energy for space cooling												1.4508	(108)
Total												52.6590	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652 (71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658 (72)

Total internal gains

	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.6300	0.7000	0.7700	21.9306	(75)
Southwest	8.3500	36.7938	0.6300	0.7000	0.7700	93.8930	(79)

Solar gains	115.8237	204.5750	299.2573	403.2260	481.2488	490.7896	467.7549	407.5556	334.9486	231.3159	140.0566	98.2625 (83)
Total gains	508.3486	595.5751	676.4238	757.6246	811.4850	798.6707	761.7292	705.7127	645.3569	564.6371	499.6931	478.6391 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area	0.9990	0.9978	0.9941	0.9803	0.9348	0.8160	0.6565	0.7172	0.9173	0.9888	0.9980	0.9993	(86)
MIT	19.5393	19.6930	19.9535	20.3133	20.6479	20.8871	20.9705	20.9551	20.7721	20.3393	19.8808	19.5225	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house	0.9987	0.9970	0.9918	0.9718	0.9036	0.7292	0.5157	0.5806	0.8642	0.9825	0.9972	0.9991	(89)
MIT 2	18.5484	18.7045	18.9667	19.3345	19.6542	19.8639	19.9121	19.9088	19.7769	19.3656	18.9052	18.5423	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7207	18.8765	19.1384	19.5048	19.8270	20.0419	20.0962	20.0908	19.9500	19.5350	19.0749	18.7128	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9959	0.9896	0.9676	0.9008	0.7405	0.5404	0.6042	0.8664	0.9795	0.9963	0.9987	(94)
Useful gains	507.4319	593.1621	669.3910	733.1045	730.9497	591.3996	411.6494	426.4181	559.1304	553.0788	497.8355	477.9976	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1816.7931	1754.6483	1581.1855	1305.1901	997.1450	658.0460	422.7717	445.0917	711.3938	1096.2806	1478.4834	1803.5035	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	974.1647	780.5187	678.3751	411.9016	198.0493	0.0000	0.0000	0.0000	0.0000	404.1421	706.0665	986.1764	(98)
Space heating												5139.3944	(98)
Space heating per m2											(98) / (4) =	50.9962	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7903	0.8699	0.8360	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	898.3316	778.3744	766.1862	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.6404	994.2300	930.8283	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	101.7424	160.5966	122.4937	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												384.8327	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	25.4356	40.1491	30.6234	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												96.2082 (107)
Space cooling per m2												0.9546 (108)
Energy for space heating												50.9962 (99)
Energy for space cooling												0.9546 (108)
Total												51.9508 (109)
Target Fabric Energy Efficiency (TFEE)												59.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	12.9236	0.4600	0.0000	0.7700	29.1131	(75)
Southwest	5.0200	40.4699	0.4600	0.0000	0.7700	71.9589	(79)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	148.8057	237.0155	344.0420	480.4457	560.7064	612.7102	577.3487	513.0418	418.3571	286.5717	184.4403	124.9696	(83)
Total gains	783.6970	866.7707	948.8415	1046.6335	1087.2291	1104.0139	1048.3393	993.3372	921.1312	828.1847	769.0893	742.3030	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9742	0.9629	0.9356	0.8704	0.7458	0.5320	0.3666	0.3950	0.6769	0.8873	0.9571	0.9776	(86)
MIT	19.3551	19.5402	19.9009	20.3532	20.7289	20.9416	20.9881	20.9848	20.8588	20.4137	19.8343	19.3344	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9683	0.9545	0.9204	0.8387	0.6818	0.4278	0.2374	0.2620	0.5818	0.8523	0.9457	0.9725	(89)
MIT 2	17.7061	17.9761	18.4911	19.1241	19.6071	19.8403	19.8690	19.8733	19.7701	19.2241	18.4129	17.6848	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9929	18.2482	18.7363	19.3379	19.8023	20.0319	20.0637	20.0667	19.9595	19.4310	18.6601	17.9717	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8429	18.0982	18.5863	19.1879	19.6523	19.8819	19.9137	19.9167	19.8095	19.2810	18.5101	17.8217	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9365	0.8981	0.8156	0.6683	0.4285	0.2423	0.2668	0.5756	0.8292	0.9266	0.9590	(94)
Useful gains	747.1714	811.7740	852.1369	853.6471	726.5531	473.0663	254.0597	265.0108	530.1646	686.6961	712.6262	711.8351	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1659.3877	1616.7422	1447.0439	1190.1832	852.4436	491.7198	255.7849	267.3952	583.8875	978.4535	1338.8417	1635.2224	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating												3353.1497	(98)
RHI space heating demand												3353	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9788	0.9677	0.9462	0.8980	0.8081	0.6635	0.5195	0.5641	0.7684	0.9171	0.9675	0.9818	(86)
MIT	19.1382	19.3544	19.7063	20.1731	20.5738	20.8492	20.9504	20.9342	20.7377	20.2251	19.6122	19.1116	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9741	0.9606	0.9338	0.8732	0.7592	0.5772	0.4004	0.4455	0.6946	0.8917	0.9591	0.9778	(89)
MIT 2	17.3708	17.6851	18.1926	18.8615	19.3999	19.7412	19.8353	19.8273	19.6220	18.9491	18.0735	17.3421	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6782	17.9754	18.4559	19.0896	19.6041	19.9340	20.0293	20.0198	19.8161	19.1710	18.3411	17.6499	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5282	17.8254	18.3059	18.9396	19.4541	19.7840	19.8793	19.8698	19.6661	19.0210	18.1911	17.4999	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9434	0.9121	0.8490	0.7398	0.5708	0.4025	0.4462	0.6804	0.8679	0.9419	0.9656	(94)
Useful gains	738.8506	817.7852	868.0076	877.4228	802.1829	605.1060	407.8038	425.1167	606.1943	702.7790	703.5589	706.0990	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1780.8121	1733.1852	1576.9181	1316.4450	1013.2141	666.3357	421.5104	444.6365	720.0161	1100.3578	1459.5194	1763.0500	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating												4017.3626	(98)
Space heating per m2											(98) / (4) =	39.8627	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4439.0747	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	856.5960	679.7225	582.7950	349.2773	173.4887	0.0000	0.0000	0.0000	0.0000	326.8494	601.4271	868.9188	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8894	89.8385	89.7326	89.4870	88.9832	87.3000	87.3000	87.3000	87.3000	89.4140	89.7587	89.9107	(217)
Fuel for water heating, kWh/month													
	196.1821	172.1175	178.8612	157.8293	153.3896	136.5557	128.1658	144.7599	145.8047	163.9467	176.3755	190.4295	(219)
Water heating fuel used												1944.4175	(219)
Annual totals kWh/year													
Space heating fuel - main system												4439.0747	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6889.6747	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4439.0747	3.4800	154.4798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.4175	3.4800	67.6657	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Total energy cost			408.9110	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1781	(257)
SAP value		83.5656	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4439.0747	0.2160	958.8401	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.4175	0.2160	419.9942	(264)
Space and water heating			1378.8343	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1641.5431	(272)
CO2 emissions per m2			16.2900	(273)
EI value			84.9110	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	12.9236	0.4600	0.0000	0.7700	29.1131	(75)
Southwest	5.0200	40.4699	0.4600	0.0000	0.7700	71.9589	(79)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	148.8057	237.0155	344.0420	480.4457	560.7064	612.7102	577.3487	513.0418	418.3571	286.5717	184.4403	124.9696	(83)
Total gains	783.6970	866.7707	948.8415	1046.6335	1087.2291	1104.0139	1048.3393	993.3372	921.1312	828.1847	769.0893	742.3030	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9742	0.9629	0.9356	0.8704	0.7458	0.5320	0.3666	0.3950	0.6769	0.8873	0.9571	0.9776	(86)
MIT	19.3551	19.5402	19.9009	20.3532	20.7289	20.9416	20.9881	20.9848	20.8588	20.4137	19.8343	19.3344	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9683	0.9545	0.9204	0.8387	0.6818	0.4278	0.2374	0.2620	0.5818	0.8523	0.9457	0.9725	(89)
MIT 2	17.7061	17.9761	18.4911	19.1241	19.6071	19.8403	19.8690	19.8733	19.7701	19.2241	18.4129	17.6848	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9929	18.2482	18.7363	19.3379	19.8023	20.0319	20.0637	20.0667	19.9595	19.4310	18.6601	17.9717	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8429	18.0982	18.5863	19.1879	19.6523	19.8819	19.9137	19.9167	19.8095	19.2810	18.5101	17.8217	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9365	0.8981	0.8156	0.6683	0.4285	0.2423	0.2668	0.5756	0.8292	0.9266	0.9590	(94)
Useful gains	747.1714	811.7740	852.1369	853.6471	726.5531	473.0663	254.0597	265.0108	530.1646	686.6961	712.6262	711.8351	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1659.3877	1616.7422	1447.0439	1190.1832	852.4436	491.7198	255.7849	267.3952	583.8875	978.4535	1338.8417	1635.2224	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating												3353.1497	(98)
Space heating per m2											(98) / (4) =	33.2720	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3705.1378	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	749.9325	597.7222	489.0727	267.7414	103.4945	0.0000	0.0000	0.0000	0.0000	239.8536	498.2046	759.1162	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8210	89.7685	89.6257	89.2947	88.5746	87.3000	87.3000	87.3000	87.3000	89.1823	89.6461	89.8430	(217)
Fuel for water heating, kWh/month													
	196.3315	172.2517	179.0745	158.1692	154.0972	136.5557	128.1658	144.7599	145.8047	164.3727	176.5970	190.5731	(219)
Water heating fuel used												1946.7530	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.1378	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6158.0733	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3705.1378	3.9200	145.2414	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.7530	3.9200	76.3127	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Total energy cost			395.4027	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3705.1378	0.2160	800.3098	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.7530	0.2160	420.4986	(264)
Space and water heating			1220.8084	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1483.5172	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3705.1378	1.2200	4520.2681	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.7530	1.2200	2375.0387	(264)
Space and water heating			6895.3067	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Primary energy kWh/year			8449.2872	(272)
Primary energy kWh/m2/year			83.8389	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 85

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-189 kg (12.8%)
U Solar photovoltaic panels	+ 9.2	-£ 309	-947 kg (73.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.88 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.39 kg/m²	A 94	A 95
Total Savings	£340	11.27 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£86	£94	-£8
Mains gas	£310	£270	£39
Space heating	£246	£246	£0
Water heating	£76	£46	£31
Lighting	£73	£73	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£396	£55	£340
Total cost of uses	£395	£56	£340
Delivered energy	61 kWh/m²	34 kWh/m²	27 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	11 kg/m²
Primary energy	84 kWh/m²	18 kWh/m²	66 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.4600	0.0000	0.7700	25.4172	(75)
Southwest	5.0200	36.7938	0.4600	0.0000	0.7700	65.4225	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	134.2376	237.0988	346.8339	467.3317	557.7588	568.8164	542.1195	472.3497	388.1995	268.0910	162.3231	113.8845	(83)
Total gains	769.1289	866.8539	951.6334	1033.5195	1084.2814	1060.1202	1013.1101	952.6451	890.9736	809.7040	746.9721	731.2179	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9788	0.9677	0.9462	0.8980	0.8081	0.6635	0.5195	0.5641	0.7684	0.9171	0.9675	0.9818	(86)
MIT	19.1382	19.3544	19.7063	20.1731	20.5738	20.8492	20.9504	20.9342	20.7377	20.2251	19.6122	19.1116	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9741	0.9606	0.9338	0.8732	0.7592	0.5772	0.4004	0.4455	0.6946	0.8917	0.9591	0.9778	(89)
MIT 2	17.3708	17.6851	18.1926	18.8615	19.3999	19.7412	19.8353	19.8273	19.6220	18.9491	18.0735	17.3421	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6782	17.9754	18.4559	19.0896	19.6041	19.9340	20.0293	20.0198	19.8161	19.1710	18.3411	17.6499	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5282	17.8254	18.3059	18.9396	19.4541	19.7840	19.8793	19.8698	19.6661	19.0210	18.1911	17.4999	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9434	0.9121	0.8490	0.7398	0.5708	0.4025	0.4462	0.6804	0.8679	0.9419	0.9656	(94)
Useful gains	738.8506	817.7852	868.0076	877.4228	802.1829	605.1060	407.8038	425.1167	606.1943	702.7790	703.5589	706.0990	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1780.8121	1733.1852	1576.9181	1316.4450	1013.2141	666.3357	421.5104	444.6365	720.0161	1100.3578	1459.5194	1763.0500	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating												4017.3626	(98)
Space heating per m2											(98) / (4) =	39.8627	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4439.0747	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	775.2193	615.1488	527.4295	316.0959	157.0073	0.0000	0.0000	0.0000	0.0000	295.7987	544.2916	786.3715	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	856.5960	679.7225	582.7950	349.2773	173.4887	0.0000	0.0000	0.0000	0.0000	326.8494	601.4271	868.9188	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9620	89.9898	90.0244	90.0870	90.1631	87.3000	87.3000	87.3000	87.3000	89.7147	89.8712	89.9714	(217)
Fuel for water heating, kWh/month	167.9912	125.0643	98.6681	50.1545	19.7690	2.9152	0.0000	29.5406	55.5649	103.4326	142.8704	166.8452	(219)
Water heating fuel used												962.8161	(219)
Annual totals kWh/year													
Space heating fuel - main system												4439.0747	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4230.8339	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4439.0747	3.4800	154.4798	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.8161	3.4800	33.5060	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			153.5234	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4423	(257)
SAP value	93.8298	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4439.0747	0.2160	958.8401	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.8161	0.2160	207.9683	(264)
Space and water heating			1166.8084	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			559.0299	(272)
CO2 emissions per m2			5.5500	(273)
EI value			94.8614	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2243	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-887.0104	(H17)
Solar input	-27.3017	-41.0345	-69.1072	-95.5273	-115.0470	-121.0820	-118.1746	-105.5306	-82.3670	-56.0328	-33.1860	-22.6197	(63)
								Solar input (sum of months) = Sum(63)m =				-887.0104	(63)
Output from w/h													
	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
								Total per year (kWh/year) = Sum(64)m =				851.2283	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	12.9236	0.4600	0.0000	0.7700	29.1131	(75)
Southwest	5.0200	40.4699	0.4600	0.0000	0.7700	71.9589	(79)
Southwest	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(79)

Solar gains	148.8057	237.0155	344.0420	480.4457	560.7064	612.7102	577.3487	513.0418	418.3571	286.5717	184.4403	124.9696	(83)
Total gains	783.6970	866.7707	948.8415	1046.6335	1087.2291	1104.0139	1048.3393	993.3372	921.1312	828.1847	769.0893	742.3030	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9742	0.9629	0.9356	0.8704	0.7458	0.5320	0.3666	0.3950	0.6769	0.8873	0.9571	0.9776	(86)
MIT	19.3551	19.5402	19.9009	20.3532	20.7289	20.9416	20.9881	20.9848	20.8588	20.4137	19.8343	19.3344	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9683	0.9545	0.9204	0.8387	0.6818	0.4278	0.2374	0.2620	0.5818	0.8523	0.9457	0.9725	(89)
MIT 2	17.7061	17.9761	18.4911	19.1241	19.6071	19.8403	19.8690	19.8733	19.7701	19.2241	18.4129	17.6848	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9929	18.2482	18.7363	19.3379	19.8023	20.0319	20.0637	20.0667	19.9595	19.4310	18.6601	17.9717	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8429	18.0982	18.5863	19.1879	19.6523	19.8819	19.9137	19.9167	19.8095	19.2810	18.5101	17.8217	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9534	0.9365	0.8981	0.8156	0.6683	0.4285	0.2423	0.2668	0.5756	0.8292	0.9266	0.9590	(94)
Useful gains	747.1714	811.7740	852.1369	853.6471	726.5531	473.0663	254.0597	265.0108	530.1646	686.6961	712.6262	711.8351	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1659.3877	1616.7422	1447.0439	1190.1832	852.4436	491.7198	255.7849	267.3952	583.8875	978.4535	1338.8417	1635.2224	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating												3353.1497	(98)
Space heating per m2											(98) / (4) =	33.2720	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3705.1378	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	678.6889	540.9386	442.6108	242.3060	93.6625	0.0000	0.0000	0.0000	0.0000	217.0675	450.8752	687.0002	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	749.9325	597.7222	489.0727	267.7414	103.4945	0.0000	0.0000	0.0000	0.0000	239.8536	498.2046	759.1162	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9066	89.9279	89.9358	89.9766	89.8862	87.3000	87.3000	87.3000	87.3000	89.5339	89.7851	89.9139	(217)
Fuel for water heating, kWh/month	165.7778	126.3160	101.6165	50.8014	23.8567	0.0000	0.0000	23.8772	51.4554	101.1444	139.3620	165.2658	(219)
Water heating fuel used												949.4731	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.1378	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3386.6337	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3705.1378	3.9200	145.2414	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	949.4731	3.9200	37.2193	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			55.4118	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3705.1378	0.2160	800.3098	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.4731	0.2160	205.0862	(264)
Space and water heating			1005.3959	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			347.3158 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3705.1378	1.2200	4520.2681	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.4731	1.2200	1158.3571	(264)
Space and water heating			5678.6252	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1785.9356	(272)
Primary energy kWh/m2/year			17.7211	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	343.88	(P1)
Transmission heat loss coefficient	77.96	(37)
Summer heat loss coefficient	421.84	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.3600	98.8453	0.4600	0.0000	0.9000	260.2635
South West	5.0200	119.9223	0.4600	0.0000	0.9000	249.2322
South West	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						674.8231

	Jun	Jul	Aug	
Solar gains	716	675	600	(P4)
Internal gains	488	468	477	
Total summer gains	1204	1143	1077	(P5)
Summer gain/loss ratio	2.86	2.71	2.55	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.74	21.49	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-332	**Issued on Date**	19/10/2022
Assessment Reference	Plot 332	**Prop Type Ref**	Alston-As-DET
Property	Plot 332, 4 Bed, K, WC, B, 2xEn, Extra Bay		

SAP Rating	85 B	**DER**	15.53	**TER**	16.02
Environmental	85 B	**% DER<TER**	3.06		
CO_2 Emissions (t/year)	1.98	**DFEE**	49.59	**TFEE**	58.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.75		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Detached House, total floor area 151 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.02 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.53 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H18

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.54 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 10.52 m², No overhang
Windows facing North East: 3.11 m², No overhang
Windows facing South East: 1.04 m², No overhang
Windows facing South: 19.04 m², No overhang
Windows facing North West: 2.07 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.036 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100 (1b)	x	2.5400 (2b)	=	195.0974	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3786	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3786	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4827	0.4733	0.4638	0.4165	0.4070	0.3597	0.3597	0.3502	0.3786	0.4070	0.4259	0.4449	(22b)
Effective ac	0.6165	0.6120	0.6076	0.5867	0.5828	0.5647	0.5647	0.5613	0.5717	0.5828	0.5907	0.5990	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.6185	(36)
Total fabric heat loss	(33) + (36) =	123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.4006	78.8179	78.2467	75.5640	75.0621	72.7255	72.7255	72.2928	73.6255	75.0621	76.0775	77.1390	(38)
Heat transfer coeff	202.8489	202.2662	201.6950	199.0122	198.5103	196.1737	196.1737	195.7410	197.0737	198.5103	199.5257	200.5873	(39)
Average = Sum(39)m / 12 =												199.0098	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3432	1.3393	1.3356	1.3178	1.3145	1.2990	1.2990	1.2961	1.3050	1.3145	1.3212	1.3282	(40)
HLP (average)												1.3178	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9358 (42)
Average daily hot water use (litres/day)		103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.5671	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6735	25.4676	20.7116	15.6800	11.7210	9.8954	10.6923	13.8983	18.6542	23.6858	27.6448	29.4705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	548.8371	546.5681	528.4165	498.7028	467.7422	438.4787	419.8185	426.4341	441.9978	471.9488	506.4302	533.0523	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	938.0087	1203.8840	1422.3563	1612.6131	1732.2709	1704.2492	1635.6151	1526.3090	1410.5228	1196.0502	971.3224	867.0315	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.8949	28.9781	29.0602	29.4519	29.5264	29.8781	29.8781	29.9441	29.7416	29.5264	29.3761	29.2207	
alpha	2.9263	2.9319	2.9373	2.9635	2.9684	2.9919	2.9919	2.9963	2.9828	2.9684	2.9584	2.9480	
util living area													
	0.9830	0.9652	0.9343	0.8735	0.7713	0.6264	0.4878	0.5333	0.7350	0.9060	0.9704	0.9864	(86)
MIT	18.7665	19.1007	19.5516	20.0885	20.5344	20.8277	20.9401	20.9207	20.7044	20.1046	19.3317	18.7129	(87)
Th 2	19.8072	19.8102	19.8131	19.8269	19.8295	19.8416	19.8416	19.8439	19.8370	19.8295	19.8243	19.8188	(88)
util rest of house													
	0.9795	0.9582	0.9208	0.8465	0.7209	0.5425	0.3744	0.4195	0.6611	0.8800	0.9632	0.9835	(89)
MIT 2	16.8525	17.3367	17.9843	18.7456	19.3416	19.7023	19.8100	19.7984	19.5715	18.7872	17.6845	16.7813	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.0686	17.5358	18.1612	18.8972	19.4762	19.8294	19.9376	19.9251	19.6994	18.9359	17.8705	16.9993	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9186	17.3858	18.0112	18.7472	19.3262	19.6794	19.7876	19.7751	19.5494	18.7859	17.7205	16.8493	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9658	0.9370	0.8926	0.8153	0.6956	0.5294	0.3687	0.4121	0.6397	0.8490	0.9435	0.9718	(94)
Useful gains	905.8949	1127.9843	1269.5256	1314.7990	1205.0138	902.3136	603.0875	629.0598	902.3697	1015.4007	916.4842	842.5986	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2559.6641	2525.4614	2321.7590	1959.7169	1513.8891	996.4382	625.3196	660.6528	1073.9308	1624.9843	2119.0614	2537.2986	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1230.4043	939.1046	782.8617	464.3409	229.8033	0.0000	0.0000	0.0000	0.0000	453.5302	865.8556	1260.8568	(98)
Space heating												6226.7574	(98)
Space heating per m2											(98) / (4) =	41.2313	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6872.8006	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1230.4043	939.1046	782.8617	464.3409	229.8033	0.0000	0.0000	0.0000	0.0000	453.5302	865.8556	1260.8568	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1358.0621	1036.5393	864.0857	512.5176	253.6460	0.0000	0.0000	0.0000	0.0000	500.5852	955.6905	1391.6742	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.8060	88.5814	88.1776	87.3221	85.6111	79.9000	79.9000	79.9000	79.9000	87.1844	88.3911	88.8784	(217)
Fuel for water heating, kWh/month													
	246.1215	217.3897	229.1334	207.1080	206.7885	197.6312	189.4714	208.3669	208.1424	215.1135	224.7367	239.9027	(219)
Water heating fuel used												2589.9060	(219)
Annual totals kWh/year													
Space heating fuel - main system												6872.8006	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Total delivered energy for all uses												10044.0903	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6872.8006	0.2160	1484.5249	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2589.9060	0.2160	559.4197	(264)
Space and water heating			2043.9446	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Total CO2, kg/year			2345.6827	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.5300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.5300	ZC1
Total Floor Area	TFA	151.0200	
Assumed number of occupants	N	2.9358	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6203	ZC2
CO2 emissions from cooking, equation (L16)		1.2545	ZC3
Total CO2 emissions		29.4048	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.4048	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1025	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3525	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3525	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4494	0.4406	0.4318	0.3877	0.3789	0.3349	0.3349	0.3261	0.3525	0.3789	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5932	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5786	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			33.5100	1.3258	44.4261			(27)
GF B&B J150 P/A=0.50			76.8100	0.1300	9.9853			(28a)
EW Brick AAC015	197.1500	37.7700	159.3800	0.1800	28.6884			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	3.5400		3.5400	0.1300	0.4602			(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		97.8933			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3252	(36)
Total fabric heat loss					(33) + (36) =		115.2185	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.4013	76.8962	76.4012	74.0758	73.6408	71.6155	71.6155	71.2405	72.3956	73.6408	74.5209	75.4410	(38)
Heat transfer coeff	192.6198	192.1148	191.6197	189.2944	188.8593	186.8340	186.8340	186.4590	187.6141	188.8593	189.7394	190.6596	(39)
Average = Sum(39)m / 12 =												189.2923	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2721	1.2688	1.2534	1.2506	1.2371	1.2371	1.2347	1.2423	1.2506	1.2564	1.2625	(40)
HLP (average)												1.2534	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9358	(42)
Average daily hot water use (litres/day)												103.9245	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)
Total storage loss
28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (56)
If cylinder contains dedicated solar storage
28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
221.2753 195.0098 204.7489 183.4685 179.7385 160.5247 154.0923 169.1898 168.9232 190.2499 201.2646 215.9261 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
221.2753 195.0098 204.7489 183.4685 179.7385 160.5247 154.0923 169.1898 168.9232 190.2499 201.2646 215.9261 (64)
Total per year (kWh/year) = Sum(64)m = 2244.4115 (64)
Heat gains from water heating, kWh/month
97.7656 86.6912 92.2705 84.4144 83.9546 76.7856 75.4272 80.4471 79.5781 87.4496 90.3316 95.9870 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6765	25.4703	20.7138	15.6817	11.7222	9.8964	10.6934	13.8997	18.6562	23.6883	27.6477	29.4736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	131.4053	129.0047	124.0195	117.2423	112.8422	106.6467	101.3807	108.1279	110.5252	117.5398	125.4606	129.0147	(72)
Total internal gains													
	551.7483	549.4789	531.3268	501.6126	470.6516	441.3879	422.7277	429.3437	444.9079	474.8595	509.3413	535.9635	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.6300	0.7000	0.7700	32.0096	(74)
Northeast	2.9100	11.2829	0.6300	0.7000	0.7700	10.0343	(75)
Southeast	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(77)
South	17.8400	46.7521	0.6300	0.7000	0.7700	254.8986	(78)
Northwest	1.9400	11.2829	0.6300	0.7000	0.7700	6.6895	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	314.5394	531.2513	722.4673	900.2005	1021.8838	1022.8711	982.4938	888.8431	782.7312	585.2209	375.7371	269.9326	(83)
Total gains	866.2877	1080.7301	1253.7942	1401.8131	1492.5354	1464.2590	1405.2215	1318.1868	1227.6391	1060.0804	885.0784	805.8961	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.4466	54.5898	54.7308	55.4031	55.5308	56.1327	56.1327	56.2456	55.8993	55.5308	55.2732	55.0064	
alpha	4.6298	4.6393	4.6487	4.6935	4.7021	4.7422	4.7422	4.7497	4.7266	4.7021	4.6849	4.6671	
util living area													
	0.9983	0.9950	0.9863	0.9588	0.8845	0.7333	0.5650	0.6184	0.8465	0.9739	0.9960	0.9988	(86)
MIT	19.5701	19.7725	20.0614	20.4223	20.7335	20.9253	20.9828	20.9740	20.8439	20.4310	19.9288	19.5386	(87)
Th 2	19.8601	19.8627	19.8653	19.8775	19.8798	19.8904	19.8904	19.8924	19.8863	19.8798	19.8752	19.8703	(88)
util rest of house													
	0.9977	0.9933	0.9812	0.9426	0.8385	0.6370	0.4326	0.4851	0.7711	0.9606	0.9943	0.9984	(89)
MIT 2	17.9608	18.2580	18.6789	19.2011	19.6174	19.8405	19.8842	19.8818	19.7618	19.2230	18.4957	17.9218	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	18.1425	18.4290	18.8350	19.3390	19.7434	19.9630	20.0082	20.0051	19.8840	19.3594	18.6575	18.1044	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1425	18.4290	18.8350	19.3390	19.7434	19.9630	20.0082	20.0051	19.8840	19.3594	18.6575	18.1044	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9900	0.9747	0.9324	0.8318	0.6440	0.4473	0.4995	0.7709	0.9519	0.9914	0.9973	(94)
Useful gains	863.0718	1069.8838	1222.0157	1307.0896	1241.5086	942.9628	628.5247	658.4748	946.4004	1009.0705	877.5101	803.7289	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2666.3417	2599.1126	2363.6200	1976.0349	1519.0754	1001.9863	636.7720	672.2061	1085.1568	1654.2920	2192.9061	2650.9977	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1341.6328	1027.6418	849.3536	481.6406	206.5097	0.0000	0.0000	0.0000	0.0000	480.0448	947.0851	1374.3680	(98)
Space heating												6708.2764	(98)
Space heating per m2											(98) / (4) =	44.4198	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	7174.6272	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1341.6328	1027.6418	849.3536	481.6406	206.5097	0.0000	0.0000	0.0000	0.0000	480.0448	947.0851	1374.3680	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1434.9014	1099.0821	908.3995	515.1236	220.8660	0.0000	0.0000	0.0000	0.0000	513.4169	1012.9253	1469.9123	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	221.2753	195.0098	204.7489	183.4685	179.7385	160.5247	154.0923	169.1898	168.9232	190.2499	201.2646	215.9261	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8140	88.6051	88.2028	87.2721	85.1848	79.8000	79.8000	79.8000	79.8000	87.1821	88.4221	88.8818	(217)
Fuel for water heating, kWh/month													
	249.1447	220.0887	232.1343	210.2259	210.9983	201.1587	193.0981	212.0172	211.6832	218.2214	227.6181	242.9362	(219)
Water heating fuel used												2629.3248	(219)
Annual totals kWh/year													
Space heating fuel - main system												7174.6272	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	506.4367	(232)
Total delivered energy for all uses	10385.3887	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7174.6272	0.2160	1549.7195	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2629.3248	0.2160	567.9341	(264)
Space and water heating			2117.6536	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.4367	0.5190	262.8407	(268)
Total CO2, kg/m2/year			2419.4193	(272)
Emissions per m2 for space and water heating			14.0223	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.7404	(272b)
Emissions per m2 for pumps and fans			0.2577	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0223 * 1.00) + 1.7404 + 0.2577, rounded to 2 d.p.			16.0200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100 (1b)	x	2.5400 (2b)	=	195.0974	(1b) - (3b)
First floor	74.2100 (1c)	x	2.6300 (2c)	=	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5)	=	0.1025	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3530	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3530	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4501	0.4412	0.4324	0.3883	0.3795	0.3353	0.3353	0.3265	0.3530	0.3795	0.3971	0.4148	(22b)
Effective ac	0.6013	0.5973	0.5935	0.5754	0.5720	0.5562	0.5562	0.5533	0.5623	0.5720	0.5789	0.5860	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21100.6530 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		139.7209 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.6185 (36)
Total fabric heat loss	(33) + (36) =	123.4482 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.4382	76.9317	76.4353	74.1033	73.6670	71.6360	71.6360	71.2599	72.4183	73.6670	74.5497	75.4724	(38)
Heat transfer coeff	200.8865	200.3800	199.8835	197.5516	197.1153	195.0843	195.0843	194.7081	195.8666	197.1153	197.9979	198.9206	(39)
Average = Sum(39)m / 12 =												197.5495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3302	1.3268	1.3236	1.3081	1.3052	1.2918	1.2918	1.2893	1.2970	1.3052	1.3111	1.3172	(40)
HLP (average)												1.3081	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9358 (42)
Average daily hot water use (litres/day)		103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	36.0249	31.5076	32.5130	28.3456	27.1983	23.4701	21.7485	24.9567	25.2547	29.4320	32.1273	34.8882	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6735	25.4676	20.7116	15.6800	11.7210	9.8954	10.6923	13.8983	18.6542	23.6858	27.6448	29.4705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	48.4205	46.8863	43.7003	39.3689	36.5568	32.5973	29.2318	33.5439	35.0760	39.5591	44.6212	46.8927	(72)
Total internal gains													
	465.7605	464.3578	448.0054	420.7377	391.3650	364.3375	347.5778	351.7583	366.4568	393.8762	425.4990	450.8384	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	854.9320	1121.6737	1341.9451	1534.6479	1655.8937	1630.1080	1563.3743	1451.6333	1334.9819	1117.9776	890.3912	784.8176	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.1771	29.2509	29.3235	29.6697	29.7354	30.0449	30.0449	30.1030	29.9249	29.7354	29.6028	29.4655	
alpha	2.9451	2.9501	2.9549	2.9780	2.9824	3.0030	3.0030	3.0069	2.9950	2.9824	2.9735	2.9644	
util living area													
	0.9866	0.9706	0.9421	0.8845	0.7856	0.6432	0.5041	0.5523	0.7543	0.9181	0.9761	0.9895	(86)
MIT	18.7171	19.0553	19.5119	20.0555	20.5129	20.8163	20.9354	20.9137	20.6840	20.0633	19.2795	18.6600	(87)
Th 2	19.8173	19.8199	19.8224	19.8345	19.8367	19.8473	19.8473	19.8492	19.8432	19.8367	19.8322	19.8274	(88)
util rest of house													
	0.9838	0.9646	0.9299	0.8593	0.7368	0.5596	0.3888	0.4370	0.6824	0.8948	0.9702	0.9873	(89)
MIT 2	17.7482	18.0842	18.5337	19.0650	19.4855	19.7449	19.8237	19.8150	19.6470	19.0860	18.3181	17.6985	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.8576	18.1938	18.6442	19.1769	19.6015	19.8658	19.9492	19.9390	19.7641	19.1964	18.4267	17.8071	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8576	18.1938	18.6442	19.1769	19.6015	19.8658	19.9492	19.9390	19.7641	19.1964	18.4267	17.8071	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9533	0.9142	0.8420	0.7255	0.5611	0.3997	0.4467	0.6767	0.8783	0.9603	0.9818	(94)
Useful gains	835.3961	1069.3342	1226.7626	1292.2069	1201.3750	914.5851	624.8174	648.5107	903.3547	981.9685	855.0599	770.5152	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2723.5334	2663.8125	2427.4209	2030.2083	1557.5099	1027.2839	653.3752	689.0817	1109.3993	1694.4723	2242.6545	2706.7295	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1404.7742	1071.4894	893.2898	531.3610	264.9644	0.0000	0.0000	0.0000	0.0000	530.1029	999.0682	1440.5435	(98)
Space heating												7135.5933	(98)
Space heating per m2											(98) / (4) =	47.2493	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1833.7920	1443.6235	1479.7818	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7872	0.8496	0.8224	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1443.4973	1226.5744	1216.9224	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2031.3844	1950.4193	1822.2721	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	423.2787	538.5406	450.3802	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1412.1995	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	105.8197	134.6351	112.5950	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												353.0499	(107)
Space cooling per m2												2.3378	(108)
Energy for space heating												47.2493	(99)
Energy for space cooling												2.3378	(108)
Total												49.5871	(109)
Dwelling Fabric Energy Efficiency (DFEE)												49.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1025	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3525	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3525	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4494	0.4406	0.4318	0.3877	0.3789	0.3349	0.3349	0.3261	0.3525	0.3789	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5932	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5786	0.5858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			33.5100	1.3258	44.4261			(27)
GF B&B J150 P/A=0.50			76.8100	0.1300	9.9853			(28a)
EW Brick AAC015	197.1500	37.7700	159.3800	0.1800	28.6884			(29a)
Plane Ceiling	74.2100		74.2100	0.1300	9.6473			(30)
Bay	3.5400		3.5400	0.1300	0.4602			(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		97.8933			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3252	(36)
Total fabric heat loss					(33) + (36) =		115.2185	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.4013	76.8962	76.4012	74.0758	73.6408	71.6155	71.6155	71.2405	72.3956	73.6408	74.5209	75.4410	(38)
Heat transfer coeff	192.6198	192.1148	191.6197	189.2944	188.8593	186.8340	186.8340	186.4590	187.6141	188.8593	189.7394	190.6596	(39)
Average = Sum(39)m / 12 =												189.2923	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2755	1.2721	1.2688	1.2534	1.2506	1.2371	1.2371	1.2347	1.2423	1.2506	1.2564	1.2625	(40)
HLP (average)												1.2534	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9358	(42)
Average daily hot water use (litres/day)												103.9245	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	36.0249	31.5076	32.5130	28.3456	27.1983	23.4701	21.7485	24.9567	25.2547	29.4320	32.1273	34.8882	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	146.7884	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.6765	25.4703	20.7138	15.6817	11.7222	9.8964	10.6934	13.8997	18.6562	23.6883	27.6477	29.4736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.6299	324.9674	316.5570	298.6522	276.0506	254.8083	240.6171	237.2796	245.6900	263.5948	286.1964	307.4387	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	37.6788	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	48.4205	46.8863	43.7003	39.3689	36.5568	32.5973	29.2318	33.5439	35.0760	39.5591	44.6212	46.8927	(72)
Total internal gains													
	465.7635	464.3604	448.0076	420.7393	391.3662	364.3385	347.5789	351.7598	366.4588	393.8787	425.5019	450.8415	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.6300	0.7000	0.7700	32.0096	(74)
Northeast	2.9100	11.2829	0.6300	0.7000	0.7700	10.0343	(75)
Southeast	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(77)
South	17.8400	46.7521	0.6300	0.7000	0.7700	254.8986	(78)
Northwest	1.9400	11.2829	0.6300	0.7000	0.7700	6.6895	(81)

Solar gains	314.5394	531.2513	722.4673	900.2005	1021.8838	1022.8711	982.4938	888.8431	782.7312	585.2209	375.7371	269.9326	(83)
Total gains	780.3028	995.6117	1170.4749	1320.9398	1413.2500	1387.2097	1330.0726	1240.6029	1149.1900	979.0997	801.2390	720.7740	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.4466	54.5898	54.7308	55.4031	55.5308	56.1327	56.1327	56.2456	55.8993	55.5308	55.2732	55.0064	
alpha	4.6298	4.6393	4.6487	4.6935	4.7021	4.7422	4.7422	4.7497	4.7266	4.7021	4.6849	4.6671	
util living area													
	0.9989	0.9965	0.9895	0.9666	0.9010	0.7595	0.5923	0.6494	0.8707	0.9806	0.9974	0.9993	(86)
MIT	19.5182	19.7219	20.0137	20.3813	20.7050	20.9129	20.9791	20.9681	20.8202	20.3869	19.8786	19.4870	(87)
Th 2	19.8601	19.8627	19.8653	19.8775	19.8798	19.8904	19.8904	19.8924	19.8863	19.8798	19.8752	19.8703	(88)
util rest of house													
	0.9985	0.9952	0.9856	0.9530	0.8592	0.6646	0.4557	0.5129	0.8011	0.9704	0.9962	0.9990	(89)
MIT 2	18.5116	18.7168	19.0086	19.3775	19.6779	19.8497	19.8851	19.8833	19.7854	19.3897	18.8834	18.4885	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	18.6252	18.8303	19.1221	19.4908	19.7939	19.9698	20.0086	20.0057	19.9022	19.5023	18.9957	18.6012	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6252	18.8303	19.1221	19.4908	19.7939	19.9698	20.0086	20.0057	19.9022	19.5023	18.9957	18.6012	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9936	0.9820	0.9469	0.8553	0.6722	0.4711	0.5280	0.8023	0.9656	0.9949	0.9986	(94)
Useful gains	778.6860	989.2229	1149.4369	1250.8328	1208.8076	932.5235	626.5991	655.0322	921.9841	945.3782	797.1901	719.7392	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2759.3230	2676.2091	2418.6379	2004.7841	1528.6024	1003.2543	636.8478	672.3243	1088.5781	1681.2770	2257.0895	2745.7241	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1473.5939	1133.6547	944.2855	542.8449	237.9273	0.0000	0.0000	0.0000	0.0000	547.5087	1051.1276	1507.3327	(98)
Space heating												7438.2755	(98)
Space heating per m2											(98) / (4) =	49.2536	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1756.2400	1382.5719	1417.0883	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8238	0.8952	0.8668	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1446.7529	1237.7211	1228.3419	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1747.4786	1677.7305	1575.6152	0.0000	0.0000	0.0000	0.0000	(103)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	216.5225	327.3670	258.3713	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												802.2608 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	54.1306	81.8417	64.5928	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												200.5652 (107)
Space cooling per m2												1.3281 (108)
Energy for space heating												49.2536 (99)
Energy for space cooling												1.3281 (108)
Total												50.5816 (109)
Target Fabric Energy Efficiency (TFEE)												58.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1281	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3786	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3786	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3975	0.3786	0.3786	0.3502	0.3502	0.3124	0.3218	0.3029	0.3124	0.3313	0.3313	0.3597	(22b)
Effective ac	0.5790	0.5717	0.5717	0.5613	0.5613	0.5488	0.5518	0.5459	0.5488	0.5549	0.5549	0.5647	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	74.5717	73.6255	73.6255	72.2928	72.2928	70.6773	71.0639	70.3023	70.6773	71.4620	71.4620	72.7255	(38)
Heat transfer coeff	198.0199	197.0737	197.0737	195.7410	195.7410	194.1256	194.5121	193.7506	194.1256	194.9102	194.9102	196.1737	(39)
Average = Sum(39)m / 12 =												195.5131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3112	1.3050	1.3050	1.2961	1.2961	1.2854	1.2880	1.2829	1.2854	1.2906	1.2906	1.2990	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.5671	(64)
RHI water heating demand												2213	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	797.4914	792.0572	762.6293	716.5495	668.5181	626.0536	601.5990	611.3798	638.2198	684.5370	736.0891	775.9123	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	11.9814	0.4600	0.0000	0.7700	44.6450	(74)
Northeast	3.1100	12.9236	0.4600	0.0000	0.7700	14.2361	(75)
Southeast	1.0400	40.4699	0.4600	0.0000	0.7700	14.9078	(77)
South	9.5500	50.9848	0.4600	0.0000	0.7700	172.4618	(78)
Northwest	2.0700	12.9236	0.4600	0.0000	0.7700	9.4755	(81)
South	9.4900	50.9848	0.4600	0.0000	0.7700	171.3782	(78)

Solar gains	427.1045	649.3278	875.1312	1131.8899	1260.2112	1353.8317	1284.7571	1182.1495	1030.3275	764.3193	522.6675	363.0454	(83)
Total gains	1224.5958	1441.3850	1637.7605	1848.4394	1928.7293	1979.8852	1886.3561	1793.5293	1668.5473	1448.8563	1258.7566	1138.9577	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.5995	29.7416	29.7416	29.9441	29.9441	30.1933	30.1333	30.2517	30.1933	30.0718	30.0718	29.8781	
alpha	2.9733	2.9828	2.9828	2.9963	2.9963	3.0129	3.0089	3.0168	3.0129	3.0048	3.0048	2.9919	
util living area													
	0.9622	0.9399	0.8959	0.8067	0.6672	0.4593	0.3126	0.3364	0.5903	0.8304	0.9345	0.9683	(86)
MIT	19.1999	19.4623	19.8899	20.3748	20.7439	20.9436	20.9877	20.9846	20.8702	20.4221	19.7529	19.1517	(87)
Th 2	19.8321	19.8370	19.8370	19.8439	19.8439	19.8523	19.8503	19.8542	19.8523	19.8482	19.8482	19.8416	(88)
util rest of house													
	0.9546	0.9283	0.8753	0.7688	0.6018	0.3649	0.1998	0.2201	0.4986	0.7879	0.9195	0.9618	(89)
MIT 2	17.4926	17.8695	18.4731	19.1380	19.6034	19.8182	19.8470	19.8498	19.7563	19.2209	18.2981	17.4297	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.6854	18.0493	18.6330	19.2776	19.7321	19.9453	19.9758	19.9779	19.8820	19.3565	18.4623	17.6241	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5354	17.8993	18.4830	19.1276	19.5821	19.7953	19.8258	19.8279	19.7320	19.2065	18.3123	17.4741	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9328	0.9016	0.8447	0.7410	0.5853	0.3600	0.1973	0.2173	0.4880	0.7589	0.8918	0.9420	(94)
Useful gains	1142.3313	1299.5221	1383.3425	1369.7677	1128.8916	712.7692	372.2631	389.7517	814.2966	1099.4875	1122.5633	1072.9056	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	2462.4539	2423.8785	2184.1729	1806.2219	1288.3919	736.7589	374.5838	392.9033	879.7831	1482.5908	2009.9792	2427.4680 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	982.1712	755.5675	595.8179	314.2471	118.6682	0.0000	0.0000	0.0000	0.0000	285.0289	638.9395	1007.7945 (98)
Space heating												4698.2347 (98)
RHI space heating demand												4698 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3786	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3786	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4827	0.4733	0.4638	0.4165	0.4070	0.3597	0.3597	0.3502	0.3786	0.4070	0.4259	0.4449	(22b)
Effective ac	0.6165	0.6120	0.6076	0.5867	0.5828	0.5647	0.5647	0.5613	0.5717	0.5828	0.5907	0.5990	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.4006	78.8179	78.2467	75.5640	75.0621	72.7255	72.7255	72.2928	73.6255	75.0621	76.0775	77.1390	(38)
Heat transfer coeff	202.8489	202.2662	201.6950	199.0122	198.5103	196.1737	196.1737	195.7410	197.0737	198.5103	199.5257	200.5873	(39)
Average = Sum(39)m / 12 =												199.0098	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3432	1.3393	1.3356	1.3178	1.3145	1.2990	1.2990	1.2961	1.3050	1.3145	1.3212	1.3282	(40)
HLP (average)												1.3178	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.5671	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	797.4914	792.0572	762.6293	716.5495	668.5181	626.0536	601.5990	611.3798	638.2198	684.5370	736.0891	775.9123	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	1186.6629	1449.3732	1656.5690	1830.4598	1933.0469	1891.8241	1817.3956	1711.2547	1606.7449	1408.6384	1200.9813	1109.8915	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.8949	28.9781	29.0602	29.4519	29.5264	29.8781	29.8781	29.9441	29.7416	29.5264	29.3761	29.2207	
alpha	2.9263	2.9319	2.9373	2.9635	2.9684	2.9919	2.9919	2.9963	2.9828	2.9684	2.9584	2.9480	
util living area													
	0.9693	0.9461	0.9086	0.8394	0.7306	0.5824	0.4466	0.4867	0.6835	0.8692	0.9505	0.9743	(86)
MIT	18.9732	19.2904	19.7115	20.2052	20.6039	20.8590	20.9528	20.9381	20.7605	20.2330	19.5130	18.9186	(87)
Th 2	19.8072	19.8102	19.8131	19.8269	19.8295	19.8416	19.8416	19.8439	19.8370	19.8295	19.8243	19.8188	(88)
util rest of house													
	0.9633	0.9358	0.8910	0.8080	0.6771	0.4996	0.3399	0.3789	0.6066	0.8364	0.9393	0.9692	(89)
MIT 2	17.1501	17.6060	18.2055	18.8979	19.4218	19.7302	19.8173	19.8094	19.6280	18.9552	17.9415	17.0783	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	17.3560	17.7962	18.3755	19.0454	19.5553	19.8576	19.9455	19.9368	19.7559	19.0995	18.1189	17.2861	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2060	17.6462	18.2255	18.8954	19.4053	19.7076	19.7955	19.7868	19.6059	18.9495	17.9689	17.1361	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9435	0.9097	0.8604	0.7779	0.6550	0.4892	0.3354	0.3732	0.5893	0.8052	0.9140	0.9515	(94)
Useful gains	1119.6147	1318.5209	1425.2442	1423.9010	1266.2236	925.5496	609.6235	638.6919	946.8902	1134.2940	1097.7480	1056.0606	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2617.9586	2578.1178	2364.9776	1989.2160	1529.5729	1001.9777	626.8679	662.9347	1085.0594	1657.4590	2168.6288	2594.8072	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1114.7679	846.4491	699.1616	407.0268	195.9319	0.0000	0.0000	0.0000	0.0000	389.2348	771.0342	1144.8275	(98)
Space heating												5568.4336	(98)
Space heating per m2											(98) / (4) =	36.8722	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6146.1740	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1114.7679	846.4491	699.1616	407.0268	195.9319	0.0000	0.0000	0.0000	0.0000	389.2348	771.0342	1144.8275	(98)
Space heating efficiency (main heating system 1)													
	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)													
	1230.4281	934.2705	771.7016	449.2569	216.2603	0.0000	0.0000	0.0000	0.0000	429.6189	851.0311	1263.6065	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.6538	88.4058	87.9592	87.0152	85.1851	79.9000	79.9000	79.9000	79.9000	86.8195	88.1808	88.7343	(217)
Fuel for water heating, kWh/month													
	246.5441	217.8216	229.7024	207.8386	207.8226	197.6312	189.4714	208.3669	208.1424	216.0176	225.2725	240.2922	(219)
Water heating fuel used												2594.9235	(219)
Annual totals kWh/year													
Space heating fuel - main system												6146.1740	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Total delivered energy for all uses												9322.4812	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6146.1740	3.4800	213.8869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2594.9235	3.4800	90.3033	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	506.3836	13.1900	66.7920	(250)
Additional standing charges			120.0000	(251)
Total energy cost			500.8747	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0732	(257)
SAP value		85.0290	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6146.1740	0.2160	1327.5736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.9235	0.2160	560.5035	(264)
Space and water heating			1888.0771	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Total kg/year			2189.8152	(272)
CO2 emissions per m2			14.5000	(273)
EI value			85.0303	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8505 = 4.092, stars = 4
Water heating environmental impact	0.216 / 0.8505 = 0.2540, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3786	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3786	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3975	0.3786	0.3786	0.3502	0.3502	0.3124	0.3218	0.3029	0.3124	0.3313	0.3313	0.3597	(22b)
Effective ac	0.5790	0.5717	0.5717	0.5613	0.5613	0.5488	0.5518	0.5459	0.5488	0.5549	0.5549	0.5647	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	74.5717	73.6255	73.6255	72.2928	72.2928	70.6773	71.0639	70.3023	70.6773	71.4620	71.4620	72.7255	(38)
Heat transfer coeff	198.0199	197.0737	197.0737	195.7410	195.7410	194.1256	194.5121	193.7506	194.1256	194.9102	194.9102	196.1737	(39)
Average = Sum(39)m / 12 =												195.5131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3112	1.3050	1.3050	1.2961	1.2961	1.2854	1.2880	1.2829	1.2854	1.2906	1.2906	1.2990	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.5671	(64)
Heat gains from water heating, kWh/month													
	95.6019	84.7369	90.1069	82.3205	81.7909	74.6917	73.2635	78.2835	77.4842	85.2860	88.2378	93.8233	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	128.4972	126.0965	121.1114	114.3341	109.9340	103.7385	98.4725	105.2197	107.6170	114.6317	122.5524	126.1066	(72)
Total internal gains													
	797.4914	792.0572	762.6293	716.5495	668.5181	626.0536	601.5990	611.3798	638.2198	684.5370	736.0891	775.9123	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	11.9814	0.4600	0.0000	0.7700	44.6450	(74)
Northeast	3.1100	12.9236	0.4600	0.0000	0.7700	14.2361	(75)
Southeast	1.0400	40.4699	0.4600	0.0000	0.7700	14.9078	(77)
South	9.5500	50.9848	0.4600	0.0000	0.7700	172.4618	(78)
Northwest	2.0700	12.9236	0.4600	0.0000	0.7700	9.4755	(81)
South	9.4900	50.9848	0.4600	0.0000	0.7700	171.3782	(78)

Solar gains	427.1045	649.3278	875.1312	1131.8899	1260.2112	1353.8317	1284.7571	1182.1495	1030.3275	764.3193	522.6675	363.0454	(83)
Total gains	1224.5958	1441.3850	1637.7605	1848.4394	1928.7293	1979.8852	1886.3561	1793.5293	1668.5473	1448.8563	1258.7566	1138.9577	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.5995	29.7416	29.7416	29.9441	29.9441	30.1933	30.1333	30.2517	30.1933	30.0718	30.0718	29.8781	
alpha	2.9733	2.9828	2.9828	2.9963	2.9963	3.0129	3.0089	3.0168	3.0129	3.0048	3.0048	2.9919	
util living area													
	0.9622	0.9399	0.8959	0.8067	0.6672	0.4593	0.3126	0.3364	0.5903	0.8304	0.9345	0.9683	(86)
MIT	19.1999	19.4623	19.8899	20.3748	20.7439	20.9436	20.9877	20.9846	20.8702	20.4221	19.7529	19.1517	(87)
Th 2	19.8321	19.8370	19.8370	19.8439	19.8439	19.8523	19.8503	19.8542	19.8523	19.8482	19.8482	19.8416	(88)
util rest of house													
	0.9546	0.9283	0.8753	0.7688	0.6018	0.3649	0.1998	0.2201	0.4986	0.7879	0.9195	0.9618	(89)
MIT 2	17.4926	17.8695	18.4731	19.1380	19.6034	19.8182	19.8470	19.8498	19.7563	19.2209	18.2981	17.4297	(90)
Living area fraction										fLA = Living area / (4) =		0.1129	(91)
MIT	17.6854	18.0493	18.6330	19.2776	19.7321	19.9453	19.9758	19.9779	19.8820	19.3565	18.4623	17.6241	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5354	17.8993	18.4830	19.1276	19.5821	19.7953	19.8258	19.8279	19.7320	19.2065	18.3123	17.4741	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9328	0.9016	0.8447	0.7410	0.5853	0.3600	0.1973	0.2173	0.4880	0.7589	0.8918	0.9420	(94)
Useful gains	1142.3313	1299.5221	1383.3425	1369.7677	1128.8916	712.7692	372.2631	389.7517	814.2966	1099.4875	1122.5633	1072.9056	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2462.4539	2423.8785	2184.1729	1806.2219	1288.3919	736.7589	374.5838	392.9033	879.7831	1482.5908	2009.9792	2427.4680	(97)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	982.1712	755.5675	595.8179	314.2471	118.6682	0.0000	0.0000	0.0000	0.0000	285.0289	638.9395	1007.7945	(98)
Space heating												4698.2347	(98)
Space heating per m2											(98) / (4) =	31.1100	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.6000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5185.6895	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	982.1712	755.5675	595.8179	314.2471	118.6682	0.0000	0.0000	0.0000	0.0000	285.0289	638.9395	1007.7945	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1084.0742	833.9597	657.6356	346.8510	130.9804	0.0000	0.0000	0.0000	0.0000	314.6015	705.2312	1112.3559	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.5707	192.5669	202.0443	180.8511	177.0340	157.9073	151.3877	166.4852	166.3058	187.5453	198.6472	213.2215	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.4440	88.2010	87.6283	86.3747	83.8753	79.9000	79.9000	79.9000	79.9000	86.0279	87.8111	88.5297	(217)
Fuel for water heating, kWh/month	247.1290	218.3273	230.5696	209.3796	211.0681	197.6312	189.4714	208.3669	208.1424	218.0052	226.2212	240.8475	(219)
Water heating fuel used												2605.1594	(219)
Annual totals kWh/year													
Space heating fuel - main system												5185.6895	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Total delivered energy for all uses												8372.2326	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5185.6895	3.9200	203.2790	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2605.1594	3.9200	102.1222	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	506.3836	16.9600	85.8827	(250)
Additional standing charges			88.0000	(251)
Total energy cost			492.0039	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5185.6895	0.2160	1120.1089	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2605.1594	0.2160	562.7144	(264)
Space and water heating			1682.8234	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Total kg/year			1984.5615	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5185.6895	1.2200	6326.5412	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2605.1594	1.2200	3178.2945	(264)
Space and water heating			9504.8357	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	506.3836	3.0700	1554.5978	(268)
Primary energy kWh/year			11289.6835	(272)
Primary energy kWh/m2/year			74.7562	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 85

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 44	-266 kg (13.4%)
U Solar photovoltaic panels	+ 6.8	-£ 309	-947 kg (55.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.76 kg/m²	B 86	B 87
Solar photovoltaic panels	£309	6.27 kg/m²	A 93	A 93
Total Savings	£354	8.03 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£99	£107	-£8
Mains gas	£393	£340	£53
Space heating	£304	£305	-£1
Water heating	£102	£56	£46
Lighting	£86	£86	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£492	£138	£354
Total cost of uses	£492	£138	£354
Delivered energy	55 kWh/m²	35 kWh/m²	21 kWh/m²
Carbon dioxide emissions	2.0 tonnes	0.8 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	5 kg/m²	8 kg/m²
Primary energy	75 kWh/m²	28 kWh/m²	47 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3786	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3786	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4827	0.4733	0.4638	0.4165	0.4070	0.3597	0.3597	0.3502	0.3786	0.4070	0.4259	0.4449	(22b)
Effective ac	0.6165	0.6120	0.6076	0.5867	0.5828	0.5647	0.5647	0.5613	0.5717	0.5828	0.5907	0.5990	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.4006	78.8179	78.2467	75.5640	75.0621	72.7255	72.7255	72.2928	73.6255	75.0621	76.0775	77.1390	(38)
Heat transfer coeff	202.8489	202.2662	201.6950	199.0122	198.5103	196.1737	196.1737	195.7410	197.0737	198.5103	199.5257	200.5873	(39)
Average = Sum(39)m / 12 =												199.0098	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3432	1.3393	1.3356	1.3178	1.3145	1.2990	1.2990	1.2961	1.3050	1.3145	1.3212	1.3282	(40)
HLP (average)												1.3178	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	16.5726	14.9688	16.5726	16.0380	16.5726	16.0380	16.5726	16.5726	16.0380	16.5726	16.0380	16.5726	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.3637	184.2509	191.4416	165.1875	155.0326	136.3906	129.1537	145.1817	151.9929	176.9426	189.7372	204.0145	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1091	(H8)
Utilisation factor												0.5941	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												103.9245	(H14)
Volume ratio Veff/V												1.1114	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-947.3706	(H17)
Solar input	-27.4719	-45.8426	-78.0753	-104.6362	-129.2692	-127.0923	-125.4127	-109.5737	-85.8182	-58.6037	-32.5856	-22.9893	(63)
								Solar input (sum of months) = Sum(63)m =				-947.3706	(63)
Output from w/h													
	181.8919	138.4083	113.3663	60.5513	25.7634	9.2984	3.7411	35.6080	66.1748	118.3389	157.1516	181.0253	(64)
								Total per year (kWh/year) = Sum(64)m =				1091.3192	(64)
Heat gains from water heating, kWh/month													
	88.2363	78.0841	81.6247	69.7897	64.1899	57.4784	55.4764	61.2407	66.0339	76.8038	81.1098	86.4577	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	118.5972	116.1965	109.7106	96.9301	86.2767	79.8311	74.5650	82.3128	91.7138	103.2309	112.6524	116.2066	(72)
Total internal gains													
	787.5914	782.1572	751.2285	699.1455	644.8608	602.1461	577.6916	588.4728	622.3166	673.1362	726.1891	766.0123	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	10.6334	0.4600	0.0000	0.7700	39.6220	(74)
Northeast	3.1100	11.2829	0.4600	0.0000	0.7700	12.4289	(75)
Southeast	1.0400	36.7938	0.4600	0.0000	0.7700	13.5537	(77)
South	9.5500	46.7521	0.4600	0.0000	0.7700	158.1440	(78)
Northwest	2.0700	11.2829	0.4600	0.0000	0.7700	8.2726	(81)
South	9.4900	46.7521	0.4600	0.0000	0.7700	157.1504	(78)

Solar gains	389.1715	657.3160	893.9397	1113.9103	1264.5287	1265.7705	1215.7966	1099.8749	968.5251	724.1013	464.8922	333.9792	(83)
Total gains	1176.7629	1439.4732	1645.1682	1813.0558	1909.3895	1867.9166	1793.4882	1688.3478	1590.8417	1397.2376	1191.0813	1099.9915	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.8949	28.9781	29.0602	29.4519	29.5264	29.8781	29.8781	29.9441	29.7416	29.5264	29.3761	29.2207	
alpha	2.9263	2.9319	2.9373	2.9635	2.9684	2.9919	2.9919	2.9963	2.9828	2.9684	2.9584	2.9480	
util living area													
	0.9700	0.9469	0.9099	0.8422	0.7353	0.5877	0.4517	0.4921	0.6875	0.8712	0.9515	0.9749	(86)
MIT	18.9652	19.2830	19.7041	20.1964	20.5963	20.8555	20.9513	20.9362	20.7565	20.2266	19.5055	18.9104	(87)
Th 2	19.8072	19.8102	19.8131	19.8269	19.8295	19.8416	19.8416	19.8439	19.8370	19.8295	19.8243	19.8188	(88)
util rest of house													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9640	0.9368	0.8925	0.8111	0.6821	0.5048	0.3441	0.3835	0.6108	0.8388	0.9405	0.9699	(89)
MIT 2	17.1386	17.5956	18.1953	18.8865	19.4132	19.7270	19.8164	19.8082	19.6240	18.9469	17.9309	17.0665	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	17.3448	17.7861	18.3656	19.0344	19.5468	19.8544	19.9446	19.9356	19.7518	19.0914	18.1087	17.2747	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1948	17.6361	18.2156	18.8844	19.3968	19.7044	19.7946	19.7856	19.6018	18.9414	17.9587	17.1247	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9445	0.9109	0.8619	0.7809	0.6597	0.4941	0.3395	0.3777	0.5932	0.8076	0.9154	0.9524	(94)
Useful gains	1111.4057	1311.1637	1418.0498	1415.7323	1259.5832	922.9100	608.8805	637.6672	943.6930	1128.3795	1090.2953	1047.6427	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2615.7041	2576.0771	2362.9831	1987.0225	1527.8878	1001.3532	626.6923	662.6929	1084.2696	1655.8534	2166.5813	2592.5228	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1119.1980	850.0218	703.0304	411.3289	199.6186	0.0000	0.0000	0.0000	0.0000	392.4406	774.9259	1149.3908	(98)
Space heating												5599.9552	(98)
Space heating per m2											(98) / (4) =	37.0809	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6180.9660	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1119.1980	850.0218	703.0304	411.3289	199.6186	0.0000	0.0000	0.0000	0.0000	392.4406	774.9259	1149.3908	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1235.3179	938.2139	775.9717	454.0054	220.3296	0.0000	0.0000	0.0000	0.0000	433.1574	855.3266	1268.6433	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	181.8919	138.4083	113.3663	60.5513	25.7634	9.2984	3.7411	35.6080	66.1748	118.3389	157.1516	181.0253	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.9350	88.9323	88.9460	89.0694	89.2340	79.9000	79.9000	79.9000	79.9000	87.8736	88.5995	88.9787	(217)
Fuel for water heating, kWh/month	204.5223	155.6333	127.4553	67.9821	28.8717	11.6375	4.6822	44.5657	82.8220	134.6694	177.3730	203.4480	(219)
Water heating fuel used												1243.6625	(219)
Annual totals kWh/year													
Space heating fuel - main system												6180.9660	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												6328.7727	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6180.9660	3.4800	215.0976	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1243.6625	3.4800	43.2795	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	506.3836	13.1900	66.7920	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			233.8337	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.5010	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	93.0108	
SAP rating (Section 12)	93	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6180.9660	0.2160	1335.0886	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1243.6625	0.2160	268.6311	(264)
Space and water heating			1603.7198	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			1034.9706	(272)
CO2 emissions per m2			6.8500	(273)
EI value			92.9249	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	76.8100	(1b)	x 2.5400	(2b) =	195.0974	(1b) - (3b)
First floor	74.2100	(1c)	x 2.6300	(2c) =	195.1723	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		390.2697	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3786	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3786	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3975	0.3786	0.3786	0.3502	0.3502	0.3124	0.3218	0.3029	0.3124	0.3313	0.3313	0.3597	(22b)
Effective ac	0.5790	0.5717	0.5717	0.5613	0.5613	0.5488	0.5518	0.5459	0.5488	0.5549	0.5549	0.5647	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			26.2900	1.2357	32.4876			(27)
French Door (Uw = 1.30)			9.4900	1.2357	11.7272			(27)
GF B&B J150 P/A=0.50			76.8100	0.1200	9.2172	75.0000	5760.7500	(28a)
EW Brick AAC015	197.1500	40.0400	157.1100	0.2500	39.2775	52.3000	8216.8530	(29a)
Plane Ceiling	74.2100		74.2100	0.1600	11.8736	9.0000	667.8900	(30)
Bay	3.5400		3.5400	0.1400	0.4956	9.0000	31.8600	(30)
Total net area of external elements Aum(A, m2)			351.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.8297			(33)
GF Timber			70.3600			9.0000	633.2400	(32c)
1F Timber			138.7400			9.0000	1248.6600	(32c)
GF Masonry			65.0700			39.0000	2537.7300	(32c)
Internal Floor			74.2100			18.0000	1335.7800	(32d)
Internal Ceiling			74.2100			9.0000	667.8900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21100.6530	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	139.7209	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6185	(36)
Total fabric heat loss	(33) + (36) = 123.4482	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	74.5717	73.6255	73.6255	72.2928	72.2928	70.6773	71.0639	70.3023	70.6773	71.4620	71.4620	72.7255	(38)
Heat transfer coeff	198.0199	197.0737	197.0737	195.7410	195.7410	194.1256	194.5121	193.7506	194.1256	194.9102	194.9102	196.1737	(39)
Average = Sum(39)m / 12 =												195.5131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3112	1.3050	1.3050	1.2961	1.2961	1.2854	1.2880	1.2829	1.2854	1.2906	1.2906	1.2990	(40)
HLP (average)												1.2946	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9358 (42)
Average daily hot water use (litres/day)	103.9245 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	114.3170	110.1600	106.0030	101.8460	97.6890	93.5321	93.5321	97.6890	101.8460	106.0030	110.1600	114.3170	(44)
Energy conte	169.5287	148.2709	153.0023	133.3911	127.9920	110.4473	102.3457	117.4432	118.8458	138.5033	151.1872	164.1795	(45)
Energy content (annual)										Total = Sum(45)m =		1635.1371	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4293	22.2406	22.9503	20.0087	19.1988	16.5671	15.3519	17.6165	17.8269	20.7755	22.6781	24.6269	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8316	(55)
Total storage loss													
	25.7796	23.2848	25.7796	24.9480	25.7796	24.9480	25.7796	25.7796	24.9480	25.7796	24.9480	25.7796	(56)
If cylinder contains dedicated solar storage													
	16.5726	14.9688	16.5726	16.0380	16.5726	16.0380	16.5726	16.5726	16.0380	16.5726	16.0380	16.5726	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.3637	184.2509	191.4416	165.1875	155.0326	136.3906	129.1537	145.1817	151.9929	176.9426	189.7372	204.0145	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1714	(H8)
Utilisation factor												0.5742	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												103.9245	(H14)
Volume ratio Veff/V												1.1114	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-966.9846	(H17)
Solar input	-29.7633	-44.7342	-75.3380	-104.1402	-125.4198	-131.9989	-128.8294	-115.0454	-89.7934	-61.0848	-36.1781	-24.6591	(63)
								Solar input (sum of months) = Sum(63)m =				-966.9846	(63)
Output from w/h													
	179.6004	139.5167	116.1035	61.0473	29.6128	4.3917	0.3244	30.1363	62.1996	115.8578	153.5591	179.3555	(64)
									Total per year (kWh/year) = Sum(64)m =			1071.7051	(64)
Heat gains from water heating, kWh/month													
	88.2363	78.0841	81.6247	69.7897	64.1899	57.4784	55.4764	61.2407	66.0339	76.8038	81.1098	86.4577	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	176.1461	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	71.6838	63.6690	51.7791	39.2001	29.3025	24.7384	26.7307	34.7456	46.6355	59.2145	69.1121	73.6762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	480.0446	485.0260	472.4731	445.7495	412.0158	380.3109	359.1300	354.1487	366.7016	393.4251	427.1588	458.8638	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	55.5504	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	-117.4307	(71)
Water heating gains (Table 5)													
	118.5972	116.1965	109.7106	96.9301	86.2767	79.8311	74.5650	82.3128	91.7138	103.2309	112.6524	116.2066	(72)
Total internal gains													
	787.5914	782.1572	751.2285	699.1455	644.8608	602.1461	577.6916	588.4728	622.3166	673.1362	726.1891	766.0123	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.5200	11.9814	0.4600	0.0000	0.7700	44.6450	(74)
Northeast	3.1100	12.9236	0.4600	0.0000	0.7700	14.2361	(75)
Southeast	1.0400	40.4699	0.4600	0.0000	0.7700	14.9078	(77)
South	9.5500	50.9848	0.4600	0.0000	0.7700	172.4618	(78)
Northwest	2.0700	12.9236	0.4600	0.0000	0.7700	9.4755	(81)
South	9.4900	50.9848	0.4600	0.0000	0.7700	171.3782	(78)

Solar gains	427.1045	649.3278	875.1312	1131.8899	1260.2112	1353.8317	1284.7571	1182.1495	1030.3275	764.3193	522.6675	363.0454	(83)
Total gains	1214.6958	1431.4850	1626.3597	1831.0354	1905.0720	1955.9778	1862.4486	1770.6223	1652.6441	1437.4555	1248.8566	1129.0577	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.5995	29.7416	29.7416	29.9441	29.9441	30.1933	30.1333	30.2517	30.1933	30.0718	30.0718	29.8781	
alpha	2.9733	2.9828	2.9828	2.9963	2.9963	3.0129	3.0089	3.0168	3.0129	3.0048	3.0048	2.9919	
util living area													
	0.9630	0.9409	0.8974	0.8098	0.6723	0.4640	0.3163	0.3404	0.5943	0.8328	0.9357	0.9690	(86)
MIT	19.1921	19.4551	19.8827	20.3671	20.7383	20.9420	20.9873	20.9841	20.8678	20.4166	19.7457	19.1436	(87)
Th 2	19.8321	19.8370	19.8370	19.8439	19.8439	19.8523	19.8503	19.8542	19.8523	19.8482	19.8482	19.8416	(88)
util rest of house													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9555	0.9293	0.8770	0.7722	0.6070	0.3690	0.2023	0.2228	0.5024	0.7906	0.9208	0.9626	(89)
MIT 2	17.4814	17.8593	18.4634	19.1284	19.5976	19.8172	19.8469	19.8496	19.7542	19.2141	18.2882	17.4181	(90)
Living area fraction									fLA = Living area / (4) =			0.1129	(91)
MIT	17.6745	18.0395	18.6237	19.2682	19.7264	19.9442	19.9756	19.9777	19.8799	19.3499	18.4527	17.6129	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5245	17.8895	18.4737	19.1182	19.5764	19.7942	19.8256	19.8277	19.7299	19.1999	18.3027	17.4629	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9339	0.9028	0.8464	0.7442	0.5901	0.3639	0.1998	0.2200	0.4917	0.7615	0.8933	0.9430	(94)
Useful gains	1134.4162	1292.3810	1376.5562	1362.7371	1124.2553	711.8418	372.1512	389.6011	812.5784	1094.5537	1115.6579	1064.7558	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2460.3042	2421.9303	2182.3266	1804.3851	1287.2620	736.5444	374.5545	392.8647	879.3765	1481.2908	2008.1063	2425.2774	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	986.4607	759.0571	599.4931	317.9866	121.2770	0.0000	0.0000	0.0000	0.0000	287.7324	642.5628	1012.2280	(98)
Space heating												4726.7978	(98)
Space heating per m2											(98) / (4) =	31.2992	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.6000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	5217.2161 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	986.4607	759.0571	599.4931	317.9866	121.2770	0.0000	0.0000	0.0000	0.0000	287.7324	642.5628	1012.2280	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1088.8087	837.8114	661.6922	350.9785	133.8598	0.0000	0.0000	0.0000	0.0000	317.5854	709.2305	1117.2495	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	179.6004	139.5167	116.1035	61.0473	29.6128	4.3917	0.3244	30.1363	62.1996	115.8578	153.5591	179.3555	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7690	88.7546	88.6733	88.6871	88.2798	79.9000	79.9000	79.9000	79.9000	87.2460	88.3187	88.8099	(217)
Fuel for water heating, kWh/month	202.3233	157.1939	130.9340	68.8344	33.5442	5.4965	0.4059	37.7175	77.8468	132.7945	173.8694	201.9544	(219)
Water heating fuel used												1222.9149	(219)
Annual totals kWh/year													
Space heating fuel - main system												5217.2161	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												506.3836	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												5247.3550	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5217.2161	3.9200	204.5149	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1222.9149	3.9200	47.9383	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	506.3836	16.9600	85.8827	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			138.1583	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	5217.2161	0.2160	1126.9187	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1222.9149	0.2160	264.1496	(264)
Space and water heating			1391.0683	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	506.3836	0.5190	262.8131	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			772.0176	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5217.2161	1.2200	6365.0036	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1222.9149	1.2200	1491.9562	(264)
Space and water heating			7856.9598	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	506.3836	3.0700	1554.5978	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			4195.1375	(272)
Primary energy kWh/m2/year			27.7787	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	139.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	515.16	(P1)
Transmission heat loss coefficient	123.45	(37)
Summer heat loss coefficient	638.60	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
North East	0.000	1.000	None
South East	0.000	1.000	None
South	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	10.5200	81.1852	0.4600	0.0000	0.9000	353.5842
North East	3.1100	98.8453	0.4600	0.0000	0.9000	127.2672
South East	1.0400	119.9223	0.4600	0.0000	0.9000	51.6338
South	9.5500	112.2060	0.4600	0.0000	0.9000	443.6289
North West	2.0700	98.8453	0.4600	0.0000	0.9000	84.7084
South	9.4900	112.2060	0.4600	0.0000	0.9000	440.8417
total:						1501.6641

	Jun	Jul	Aug	
Solar gains	1582	1502	1382	(P4)
Internal gains	623	599	608	
Total summer gains	2205	2100	1990	(P5)
Summer gain/loss ratio	3.45	3.29	3.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 139.7)	1.02	1.02	1.02	
Threshold temperature	20.48	22.21	21.94	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature:	Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-333	**Issued on Date**	19/10/2022
Assessment Reference	Plot 333	**Prop Type Ref**	Dawlish-Opp-DET
Property	Plot 333, 3 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.94	**TER**	18.81
Environmental	85 B	**% DER<TER**	4.64		
CO_2 Emissions (t/year)	1.44	**DFEE**	52.71	**TFEE**	60.18
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.42		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 97 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.81 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.94 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.7 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 2.34 m², No overhang
Windows facing South East: 3.33 m², No overhang
Windows facing South West: 9.99 m², No overhang
Windows facing North West: 5.62 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5732	0.5620	0.5507	0.4945	0.4833	0.4271	0.4271	0.4159	0.4496	0.4833	0.5058	0.5283	(22b)
Effective ac	0.6643	0.6579	0.6517	0.6223	0.6168	0.5912	0.5912	0.5865	0.6011	0.6168	0.6279	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	84.7268 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0546	54.5259	54.0076	51.5733	51.1179	48.9977	48.9977	48.6051	49.8144	51.1179	52.0393	53.0025	(38)
Heat transfer coeff	139.7814	139.2527	138.7344	136.3002	135.8447	133.7245	133.7245	133.3319	134.5412	135.8447	136.7661	137.7293	(39)
Average = Sum(39)m / 12 =												136.2980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4357	1.4303	1.4250	1.4000	1.3953	1.3735	1.3735	1.3695	1.3819	1.3953	1.4047	1.4146	(40)
HLP (average)												1.3999	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
Daily hot water use
            108.5156  104.5695  100.6235   96.6775   92.7315   88.7855   88.7855   92.7315   96.6775  100.6235  104.5695  108.5156 (44)
Energy conte  160.9254  140.7464  145.2377  126.6217  121.4966  104.8423   97.1518  111.4831  112.8146  131.4745  143.5147  155.8477 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =  1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.1388   21.1120   21.7857   18.9933   18.2245   15.7263   14.5728   16.7225   16.9222   19.7212   21.5272   23.3772 (46)
Water storage loss:
Total storage loss
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Combi loss    14.1428   12.7631   14.1051   13.6066   14.0270   13.5362   13.9636   14.0047   13.5746   14.0721   13.6572   14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =    0.0000 (63)
Output from w/h
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =  1717.7401 (64)
Heat gains from water heating, kWh/month
              57.0434   49.9890   51.8178   45.5034   43.9044   38.2441   35.7939   40.5693   40.9045   47.2333   51.1330   55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              22.4777   19.9645   16.2362   12.2919    9.1883    7.7572    8.3819   10.8951   14.6234   18.5677   21.6713   23.1024 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             251.9878  254.6027  248.0133  233.9854  216.2777  199.6350  188.5166  185.9018  192.4911  206.5190  224.2267  240.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685 (69)
Pumps, fans    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 (71)
Water heating gains (Table 5)
              76.6712   74.3883   69.6476   63.1991   59.0112   53.1168   48.1100   54.5286   56.8118   63.4856   71.0180   74.3979 (72)
Total internal gains
             417.8424  415.6611  400.6028  376.1820  351.1829  327.2146  311.7142  318.0311  330.6319  355.2780  383.6216  405.0753 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	11.2829	0.4600	0.0000	0.7700	9.3516	(75)
Southwest	9.9900	36.7938	0.4600	0.0000	0.7700	130.1934	(79)
Northwest	5.6200	11.2829	0.4600	0.0000	0.7700	22.4599	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

```
Solar gains   205.4027  360.4433  521.2408  692.8863  819.0297  831.9945  794.2714  697.2751  580.2281  405.9341  247.9494  174.5368 (83)
Total gains   623.2451  776.1044  921.8435 1069.0683 1170.2126 1159.2091 1105.9855 1015.3062  910.8600  761.2121  631.5710  579.6121 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          34.6996   34.8314   34.9615   35.5859   35.7052   36.2713   36.2713   36.3781   36.0512   35.7052   35.4647   35.2167
alpha         3.3133    3.3221    3.3308    3.3724    3.3803    3.4181    3.4181    3.4252    3.4034    3.3803    3.3643    3.3478
util living area
               0.9907    0.9805    0.9583    0.9041    0.8003    0.6455    0.5013    0.5564    0.7802    0.9389    0.9835    0.9927 (86)

MIT           19.0013   19.2739   19.6835   20.1989   20.6161   20.8731   20.9599   20.9428   20.7435   20.1801   19.4998   18.9668 (87)
Th 2          19.7361   19.7402   19.7442   19.7634   19.7670   19.7837   19.7837   19.7868   19.7772   19.7670   19.7597   19.7521 (88)
util rest of house
               0.9883    0.9755    0.9473    0.8779    0.7457    0.5518    0.3757    0.4289    0.7007    0.9167    0.9784    0.9908 (89)
MIT 2         17.1074   17.5049   18.0963   18.8317   19.3830   19.6911   19.7661   19.7590   19.5606   18.8252   17.8481   17.0667 (90)
Living area fraction                                                                          fLA = Living area / (4) =    0.2028 (91)
MIT           17.4914   17.8636   18.4181   19.1089   19.6330   19.9307   20.0082   19.9990   19.8004   19.0999   18.1830   17.4519 (92)
Temperature adjustment                                                                                                   -0.1500
adjusted MIT  17.3414   17.7136   18.2681   18.9589   19.4830   19.7807   19.8582   19.8490   19.6504   18.9499   18.0330   17.3019 (93)
```

---

8. Space heating requirement

```
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation   0.9810    0.9634    0.9292    0.8564    0.7311    0.5515    0.3839    0.4360    0.6910    0.8966    0.9674    0.9847 (94)
Useful gains  611.4192  747.7291  856.5502  915.5997  855.5371  639.3071  424.5803  442.6554  629.3967  682.4689  611.0105  570.7651 (95)
Ext temp.       4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            1822.9468 1784.3237 1632.6449 1371.0350 1057.2854  692.7896  435.6978  459.8647  746.7641 1134.2849 1495.2656 1804.5219 (97)
Month fracti  1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
            901.3765  696.5916  577.4145  327.9135  150.1007    0.0000    0.0000    0.0000    0.0000  336.1511  636.6636  917.9151 (98)
Space heating                                                                                                           4544.1266 (98)
Space heating per m2                                                                                  (98) / (4) =     46.6734 (99)
```

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5021.1344	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	901.3765	696.5916	577.4145	327.9135	150.1007	0.0000	0.0000	0.0000	0.0000	336.1511	636.6636	917.9151	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	995.9962	769.7145	638.0270	362.3353	165.8571	0.0000	0.0000	0.0000	0.0000	371.4377	703.4957	1014.2708	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9637	89.9049	89.7882	89.5171	88.9529	87.3000	87.3000	87.3000	87.3000	89.5086	89.8479	89.9846	(217)
Fuel for water heating, kWh/month													
	194.5988	170.7465	177.4652	156.6497	152.3542	135.5997	127.2799	143.7432	144.7757	162.6062	174.9311	188.8970	(219)
Water heating fuel used												1929.6472	(219)
Annual totals kWh/year													
Space heating fuel - main system												5021.1344	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Total delivered energy for all uses												7422.7451	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5021.1344	0.2160	1084.5650	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.6472	0.2160	416.8038	(264)
Space and water heating			1501.3688	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Total CO2, kg/year			1746.3179	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.9400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.9400	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		35.1684	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.1684	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Combi loss    50.9589   46.0274   50.9589   47.6766   47.2549   43.7846   45.2441   47.2549   47.6766   50.9589   49.3151   50.9589 (61)
Total heat required for water heating calculated for each month
              211.8843  186.7738  196.1966  174.2983  168.7515  148.6269  142.3959  158.7381  160.4912  182.4334  192.8298  206.8066 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                    Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              211.8843  186.7738  196.1966  174.2983  168.7515  148.6269  142.3959  158.7381  160.4912  182.4334  192.8298  206.8066 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   2130.2265 (64)
Heat gains from water heating, kWh/month
               66.2474   58.3050   61.0313   54.0209   52.2113   45.8062   43.6140   48.8819   49.4300   56.4550   60.0474   64.5591 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                22.5569   20.0348   16.2934   12.3351    9.2207    7.7845    8.4114   10.9335   14.6749   18.6331   21.7476   23.1838 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               251.9878  254.6027  248.0133  233.9854  216.2777  199.6350  188.5166  185.9018  192.4911  206.5190  224.2267  240.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685 (69)
Pumps, fans     3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 (71)
Water heating gains (Table 5)
                89.0423   86.7634   82.0313   75.0290   70.1765   63.6197   58.6210   65.7014   68.6528   75.8804   83.3992   86.7730 (72)
Total internal gains
               430.2925  428.1065  413.0436  388.0552  362.3805  337.7448  322.2546  329.2423  342.5243  367.7381  396.0791  417.5318 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2100	11.2829	0.6300	0.7000	0.7700	7.6206	(75)
Southeast	3.1400	36.7938	0.6300	0.7000	0.7700	35.3083	(77)
Southwest	9.4300	36.7938	0.6300	0.7000	0.7700	106.0373	(79)
Northwest	5.3100	11.2829	0.6300	0.7000	0.7700	18.3100	(81)

```
Solar gains   167.2761  293.5462  424.5206  564.3485  667.1185  677.6902  646.9586  567.9337  472.5733  330.5995  201.9268  142.1385 (83)
Total gains   597.5686  721.6527  837.5642  952.4036 1029.4991 1015.4350  969.2132  897.1760  815.0976  698.3376  598.0058  559.6703 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          52.3240   52.4690   52.6119   53.2936   53.4231   54.0344   54.0344   54.1491   53.7973   53.4231   53.1617   52.8912
alpha         4.4883    4.4979    4.5075    4.5529    4.5615    4.6023    4.6023    4.6099    4.5865    4.5615    4.5441    4.5261
util living area
               0.9977    0.9943    0.9848    0.9535    0.8704    0.7127    0.5491    0.6081    0.8454    0.9731    0.9952    0.9983 (86)

MIT           19.5406   19.7310   20.0283   20.4116   20.7362   20.9274   20.9827   20.9729   20.8325   20.4022   19.9001   19.5116 (87)
Th 2          19.8196   19.8224   19.8252   19.8384   19.8409   19.8525   19.8525   19.8546   19.8480   19.8409   19.8359   19.8307 (88)
util rest of house
               0.9969    0.9924    0.9793    0.9355    0.8205    0.6134    0.4154    0.4721    0.7682    0.9593    0.9932    0.9977 (89)
MIT 2         17.8903   18.1697   18.6025   19.1557   19.5857   19.8052   19.8464   19.8439   19.7154   19.1539   18.4267   17.8553 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.2028 (91)
MIT           18.2249   18.4863   18.8916   19.4103   19.8190   20.0327   20.0768   20.0728   19.9419   19.4070   18.7254   18.1911 (92)
Temperature adjustment                                                                                                     0.0000
adjusted MIT  18.2249   18.4863   18.8916   19.4103   19.8190   20.0327   20.0768   20.0728   19.9419   19.4070   18.7254   18.1911 (93)
```

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8. Space heating requirement

```
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9952    0.9890    0.9730    0.9270    0.8194    0.6304    0.4426    0.4995    0.7756    0.9522    0.9902    0.9964 (94)
Useful gains 594.7275  713.7150  814.9773  882.8637  843.5749  640.1482  428.9616  448.1817  632.1941  664.9494  592.1430  557.6659 (95)
Ext temp.      4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            1799.3207 1750.7194 1592.4356 1333.3971 1027.5192  679.7708  435.0374  458.5853  734.1969 1114.5927 1478.5223 1788.4903 (97)
Month fracti   1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
              896.2174  696.8669  578.4289  324.3840  136.8545    0.0000    0.0000    0.0000    0.0000  334.5346  638.1931  915.7334 (98)
Space heating                                                                                                             4521.2128 (98)
Space heating per m2                                                                                        (98) / (4) =     46.4381 (99)
```

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4840.6990	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	896.2174	696.8669	578.4289	324.3840	136.8545	0.0000	0.0000	0.0000	0.0000	334.5346	638.1931	915.7334	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	959.5475	746.1102	619.3029	347.3062	146.5252	0.0000	0.0000	0.0000	0.0000	358.1741	683.2902	980.4426	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2769	88.0589	87.6090	86.5932	84.5292	80.3000	80.3000	80.3000	80.3000	86.5580	87.8365	88.3527	(217)
Fuel for water heating, kWh/month													
	240.0224	212.1010	223.9456	201.2840	199.6370	185.0896	177.3299	197.6813	199.8645	210.7643	219.5328	234.0694	(219)
Water heating fuel used												2501.3218	(219)
Annual totals kWh/year													
Space heating fuel - main system												4840.6990	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												7815.3818	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4840.6990	0.2160	1045.5910	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2501.3218	0.2160	540.2855	(264)
Space and water heating			1585.8765	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1831.5509	(272)
Emissions per m2 for space and water heating			16.2888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2888 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			18.8100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3700	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4717	0.4624	0.4532	0.4069	0.3977	0.3515	0.3515	0.3422	0.3700	0.3977	0.4162	0.4347	(22b)
Effective ac	0.6112	0.6069	0.6027	0.5828	0.5791	0.5618	0.5618	0.5586	0.5684	0.5791	0.5866	0.5945	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6581	50.3001	49.9492	48.3009	47.9925	46.5569	46.5569	46.2911	47.1099	47.9925	48.6164	49.2686	(38)
Heat transfer coeff	135.3849	135.0269	134.6760	133.0277	132.7193	131.2837	131.2837	131.0179	131.8367	132.7193	133.3432	133.9954	(39)
Average = Sum(39)m / 12 =												133.0262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3906	1.3869	1.3833	1.3663	1.3632	1.3484	1.3484	1.3457	1.3541	1.3632	1.3696	1.3763	(40)
HLP (average)												1.3663	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Daily hot water use

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156 (44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477 (45)
Energy content (annual)										Total = Sum(45)m =		1552.1566 (45)

Distribution loss (46)m = 0.15 x (45)m

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)

Heat gains from water heating, kWh/month

	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)

Water heating gains (Table 5)

	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)

Total internal gains

	384.1344	382.7796	369.4377	347.3539	323.8733	302.0408	288.3524	292.3441	304.1161	326.3439	351.9604	372.1904	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	11.2829	0.4600	0.0000	0.7700	9.3516	(75)
Southwest	9.9900	36.7938	0.4600	0.0000	0.7700	130.1934	(79)
Northwest	5.6200	11.2829	0.4600	0.0000	0.7700	22.4599	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	205.4027	360.4433	521.2408	692.8863	819.0297	831.9945	794.2714	697.2751	580.2281	405.9341	247.9494	174.5368	(83)
Total gains	589.5371	743.2229	890.6785	1040.2402	1142.9030	1134.0353	1082.6238	989.6192	884.3441	732.2780	599.9097	546.7272	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8265	35.9215	36.0151	36.4613	36.5460	36.9457	36.9457	37.0206	36.7907	36.5460	36.3751	36.1980	
alpha	3.3884	3.3948	3.4010	3.4308	3.4364	3.4630	3.4630	3.4680	3.4527	3.4364	3.4250	3.4132	
util living area	0.9922	0.9826	0.9611	0.9075	0.8034	0.6488	0.5035	0.5611	0.7862	0.9434	0.9857	0.9939	(86)
MIT	19.0294	19.3012	19.7083	20.2132	20.6261	20.8760	20.9613	20.9437	20.7459	20.1844	19.5090	18.9857	(87)
Th 2	19.7706	19.7734	19.7762	19.7892	19.7917	19.8031	19.8031	19.8052	19.7987	19.7917	19.7867	19.7816	(88)
util rest of house	0.9902	0.9782	0.9508	0.8824	0.7499	0.5561	0.3793	0.4347	0.7085	0.9228	0.9813	0.9924	(89)
MIT 2	17.9943	18.2656	18.6678	19.1619	19.5351	19.7409	19.7914	19.7863	19.6508	19.1479	18.4837	17.9588	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.2041	18.4756	18.8788	19.3750	19.7563	19.9710	20.0286	20.0210	19.8729	19.3581	18.6916	18.1670	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2041	18.4756	18.8788	19.3750	19.7563	19.9710	20.0286	20.0210	19.8729	19.3581	18.6916	18.1670	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9865	0.9717	0.9410	0.8720	0.7481	0.5702	0.4039	0.4591	0.7141	0.9132	0.9757	0.9893	(94)
Useful gains	581.5651	722.2020	838.1518	907.0525	855.0306	646.6686	437.2735	454.3750	631.4749	668.7189	585.3346	540.8990	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1882.4098	1833.0682	1667.1245	1393.4673	1069.2303	705.1310	450.1175	474.4130	761.0763	1162.3653	1545.6650	1871.5170	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	967.8284	746.5021	616.7556	350.2187	159.3646	0.0000	0.0000	0.0000	0.0000	367.2729	691.4379	989.9798	(98)
Space heating												4889.3601	(98)
Space heating per m2											(98) / (4) =	50.2194	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1234.0670	971.4996	995.7358	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8291	0.8866	0.8575	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1023.1718	861.3358	853.8078	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1429.0298	1366.7103	1259.8117	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	292.2178	375.9987	302.0669	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												970.2834	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	73.0545	93.9997	75.5167	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												242.5708	(107)
Space cooling per m2												2.4915	(108)
Energy for space heating												50.2194	(99)
Energy for space cooling												2.4915	(108)
Total												52.7109	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2100	11.2829	0.6300	0.7000	0.7700	7.6206	(75)
Southeast	3.1400	36.7938	0.6300	0.7000	0.7700	35.3083	(77)
Southwest	9.4300	36.7938	0.6300	0.7000	0.7700	106.0373	(79)
Northwest	5.3100	11.2829	0.6300	0.7000	0.7700	18.3100	(81)

Solar gains	167.2761	293.5462	424.5206	564.3485	667.1185	677.6902	646.9586	567.9337	472.5733	330.5995	201.9268	142.1385	(83)
Total gains	551.4896	676.3961	794.0155	911.7456	991.0242	979.7583	935.3405	860.3162	776.7408	657.0088	553.9634	514.4103	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9984	0.9956	0.9876	0.9599	0.8829	0.7302	0.5663	0.6292	0.8630	0.9785	0.9965	0.9988	(86)
MIT	19.4980	19.6898	19.9902	20.3807	20.7164	20.9196	20.9804	20.9689	20.8149	20.3678	19.8597	19.4695	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9978	0.9941	0.9830	0.9439	0.8358	0.6314	0.4297	0.4908	0.7900	0.9671	0.9950	0.9984	(89)
MIT 2	18.4598	18.6531	18.9533	19.3438	19.6512	19.8161	19.8477	19.8460	19.7457	19.3394	18.8337	18.4400	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6703	18.8633	19.1635	19.5540	19.8672	20.0399	20.0774	20.0737	19.9625	19.5479	19.0417	18.6487	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6703	18.8633	19.1635	19.5540	19.8672	20.0399	20.0774	20.0737	19.9625	19.5479	19.0417	18.6487	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9923	0.9794	0.9389	0.8370	0.6491	0.4577	0.5191	0.7987	0.9632	0.9935	0.9978	(94)
Useful gains	549.8200	671.1930	777.6923	856.0732	829.4970	635.9942	428.1406	446.5503	620.3495	632.8170	550.3517	513.2694	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1856.8804	1799.3029	1627.3798	1351.6244	1033.6200	680.6708	435.1091	458.6983	736.7832	1132.4256	1518.7447	1846.9875	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	972.4530	758.0898	632.1676	356.7968	151.8676	0.0000	0.0000	0.0000	0.0000	371.7088	697.2430	992.2862	(98)
Space heating												4932.6128	(98)
Space heating per m2											(98) / (4) =	50.6636	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8452	0.9084	0.8792	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	994.0819	841.1079	834.3308	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1248.7424	1194.6003	1108.7293	0.0000	0.0000	0.0000	0.0000	(103)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	183.3555	262.9983	204.1525	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												650.5064 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	45.8389	65.7496	51.0381	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												162.6266 (107)
Space cooling per m2												1.6704 (108)
Energy for space heating												50.6636 (99)
Energy for space cooling												1.6704 (108)
Total												52.3340 (109)
Target Fabric Energy Efficiency (TFEE)												60.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4721	0.4496	0.4496	0.4159	0.4159	0.3709	0.3822	0.3597	0.3709	0.3934	0.3934	0.4271	(22b)
Effective ac	0.6114	0.6011	0.6011	0.5865	0.5865	0.5688	0.5730	0.5647	0.5688	0.5774	0.5774	0.5912	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6729	49.8144	49.8144	48.6051	48.6051	47.1393	47.4900	46.7990	47.1393	47.8513	47.8513	48.9977	(38)
Heat transfer coeff	135.3997	134.5412	134.5412	133.3319	133.3319	131.8661	132.2169	131.5258	131.8661	132.5781	132.5781	133.7245	(39)
Average = Sum(39)m / 12 =												133.1251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3907	1.3819	1.3819	1.3695	1.3695	1.3544	1.3580	1.3509	1.3544	1.3617	1.3617	1.3735	(40)
HLP (average)												1.3673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
RHI water heating demand                                                                                                                    1718 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

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[Jan]                                    Area        Solar flux              g              FF          Access          Gains
                                           m2          Table 6a     Specific data  Specific data      factor              W
                                                          W/m2      or Table 6b    or Table 6c     Table 6d
-----------------------------------------------------------------------------------------------------------------------------
Northeast                                2.3400           12.9236           0.4600         0.0000          0.7700         10.7114 (75)
Southwest                                9.9900           40.4699           0.4600         0.0000          0.7700        143.2011 (79)
Northwest                                5.6200           12.9236           0.4600         0.0000          0.7700         25.7257 (81)
Southeast                                3.3300           40.4699           0.4600         0.0000          0.7700         47.7337 (77)
-----------------------------------------------------------------------------------------------------------------------------

Solar gains    227.3719   359.6683   515.9150   710.7955   821.8787   894.7964   844.4744   755.8082   623.9051   433.0593   281.3027   191.2761 (83)
Total gains    847.6087   975.2419  1107.5924  1265.2264  1337.9334  1376.5389  1306.1774  1226.3100  1115.8456   962.4717   852.4357   794.2068 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            35.8226    36.0512    36.0512    36.3781    36.3781    36.7825    36.6849    36.8777    36.7825    36.5850    36.5850    36.2713
alpha           3.3882     3.4034     3.4034     3.4252     3.4252     3.4522     3.4457     3.4585     3.4522     3.4390     3.4390     3.4181
util living area
                0.9738     0.9577     0.9197     0.8305     0.6798     0.4585     0.3098     0.3376     0.6135     0.8628     0.9530     0.9781 (86)

MIT            19.4392    19.6595    20.0445    20.4929    20.8143    20.9667    20.9938    20.9918    20.9049    20.5079    19.9218    19.4073 (87)
Th 2           19.7705    19.7772    19.7772    19.7868    19.7868    19.7985    19.7957    19.8012    19.7985    19.7928    19.7928    19.7837 (88)
util rest of house
                0.9672     0.9474     0.8998     0.7896     0.6066     0.3567     0.1914     0.2138     0.5111     0.8191     0.9394     0.9725 (89)
MIT 2          17.7616    18.0803    18.6235    19.2346    19.6255    19.7814    19.7945    19.7994    19.7358    19.2766    18.4709    17.7245 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.2028 (91)
MIT            18.1017    18.4005    18.9116    19.4897    19.8665    20.0217    20.0376    20.0412    19.9728    19.5262    18.7651    18.0657 (92)
Temperature adjustment                                                                                                              -0.1500
adjusted MIT   17.9517    18.2505    18.7616    19.3397    19.7165    19.8717    19.8876    19.8912    19.8228    19.3762    18.6151    17.9157 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9532     0.9298     0.8786     0.7720     0.6020     0.3632     0.2006     0.2233     0.5133     0.8006     0.9212     0.9599 (94)
Useful gains  807.9153   906.7668   973.1463   976.7426   805.4154   499.9544   261.9629   273.8282   572.7902   770.5284   785.2418   762.3923 (95)
Ext temp.       5.1000     5.6000     7.4000     9.9000    13.0000    16.0000    17.9000    17.8000    15.2000    11.6000     8.0000     5.1000 (96)
Heat loss rate W
             1740.1199  1702.0160  1528.6031  1258.6161   895.5242   510.5472   262.8003   275.0427   609.5911  1030.9577  1407.3290  1713.7745 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              693.5602   534.4075   413.2598   202.9489    67.0410     0.0000     0.0000     0.0000     0.0000   193.7594   447.9028   707.8283 (98)
Space heating                                                                                                                      3260.7079 (98)
```

RHI space heating demand 3261 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5732	0.5620	0.5507	0.4945	0.4833	0.4271	0.4271	0.4159	0.4496	0.4833	0.5058	0.5283	(22b)
Effective ac	0.6643	0.6579	0.6517	0.6223	0.6168	0.5912	0.5912	0.5865	0.6011	0.6168	0.6279	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0546	54.5259	54.0076	51.5733	51.1179	48.9977	48.9977	48.6051	49.8144	51.1179	52.0393	53.0025	(38)
Heat transfer coeff	139.7814	139.2527	138.7344	136.3002	135.8447	133.7245	133.7245	133.3319	134.5412	135.8447	136.7661	137.7293	(39)
Average = Sum(39)m / 12 =												136.2980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4357	1.4303	1.4250	1.4000	1.3953	1.3735	1.3735	1.3695	1.3819	1.3953	1.4047	1.4146	(40)
HLP (average)												1.3999	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156 (44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477 (45)
Energy content (annual)										Total = Sum(45)m =		1552.1566 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306 (61)

Total heat required for water heating calculated for each month

	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (64)
								Total per year (kWh/year) = Sum(64)m =				1717.7401 (64)

Heat gains from water heating, kWh/month

	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482 (71)

Water heating gains (Table 5)

	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979 (72)

Total internal gains

	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	11.2829	0.4600	0.0000	0.7700	9.3516	(75)
Southwest	9.9900	36.7938	0.4600	0.0000	0.7700	130.1934	(79)
Northwest	5.6200	11.2829	0.4600	0.0000	0.7700	22.4599	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	205.4027	360.4433	521.2408	692.8863	819.0297	831.9945	794.2714	697.2751	580.2281	405.9341	247.9494	174.5368 (83)
Total gains	825.6395	976.0169	1112.9182	1247.3172	1335.0844	1313.7370	1255.9743	1167.7769	1072.1685	935.3465	819.0824	777.4674 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.6996	34.8314	34.9615	35.5859	35.7052	36.2713	36.2713	36.3781	36.0512	35.7052	35.4647	35.2167	
alpha	3.3133	3.3221	3.3308	3.3724	3.3803	3.4181	3.4181	3.4252	3.4034	3.3803	3.3643	3.3478	
util living area													
	0.9791	0.9634	0.9326	0.8653	0.7500	0.5897	0.4491	0.4960	0.7144	0.8997	0.9656	0.9826	(86)
MIT	19.2236	19.4828	19.8638	20.3312	20.6921	20.9042	20.9714	20.9598	20.8087	20.3290	19.6988	19.1873	(87)
Th 2	19.7361	19.7402	19.7442	19.7634	19.7670	19.7837	19.7837	19.7868	19.7772	19.7670	19.7597	19.7521	(88)
util rest of house													
	0.9740	0.9546	0.9162	0.8325	0.6905	0.4979	0.3334	0.3774	0.6291	0.8676	0.9558	0.9783	(89)
MIT 2	17.4283	17.8029	18.3466	19.0032	19.4676	19.7160	19.7715	19.7680	19.6231	19.0208	18.1314	17.3859	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.7923	18.1435	18.6542	19.2725	19.7159	19.9569	20.0148	20.0097	19.8635	19.2860	18.4492	17.7511	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6423	17.9935	18.5042	19.1225	19.5659	19.8069	19.8648	19.8597	19.7135	19.1360	18.2992	17.6011	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9614	0.9375	0.8950	0.8120	0.6795	0.4997	0.3414	0.3849	0.6240	0.8467	0.9394	0.9672	(94)
Useful gains	793.7644	915.0367	996.1048	1012.7951	907.2439	656.5246	428.8217	449.5021	669.0841	791.9141	769.4584	751.9762	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1865.0037	1823.3059	1665.4023	1393.3246	1068.5396	696.2965	436.5855	461.2835	755.2433	1159.5717	1531.6692	1845.7286	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	797.0021	610.3569	497.9574	273.9812	120.0041	0.0000	0.0000	0.0000	0.0000	273.5372	548.7918	813.7518	(98)
Space heating												3935.3824	(98)
Space heating per m2											(98) / (4) =	40.4209	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4348.4889	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	797.0021	610.3569	497.9574	273.9812	120.0041	0.0000	0.0000	0.0000	0.0000	273.5372	548.7918	813.7518	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	880.6653	674.4275	550.2292	302.7417	132.6012	0.0000	0.0000	0.0000	0.0000	302.2511	606.3998	899.1732	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9065	89.8382	89.7029	89.3907	88.7742	87.3000	87.3000	87.3000	87.3000	89.3624	89.7674	89.9304	(217)
Fuel for water heating, kWh/month													
	194.7226	170.8733	177.6340	156.8713	152.6610	135.5997	127.2799	143.7432	144.7757	162.8723	175.0879	189.0109	(219)
Water heating fuel used												1931.1317	(219)
Annual totals kWh/year													
Space heating fuel - main system												4348.4889	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Total delivered energy for all uses												6751.5841	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4348.4889	3.4800	151.3274	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1931.1317	3.4800	67.2034	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Total energy cost			400.7828	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1824	(257)
SAP value		83.5053	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4348.4889	0.2160	939.2736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1931.1317	0.2160	417.1244	(264)
Space and water heating			1356.3980	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Total kg/year			1601.3471	(272)
CO2 emissions per m2			16.4500	(273)
EI value			84.9269	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8882 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8882 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4721	0.4496	0.4496	0.4159	0.4159	0.3709	0.3822	0.3597	0.3709	0.3934	0.3934	0.4271	(22b)
Effective ac	0.6114	0.6011	0.6011	0.5865	0.5865	0.5688	0.5730	0.5647	0.5688	0.5774	0.5774	0.5912	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6729	49.8144	49.8144	48.6051	48.6051	47.1393	47.4900	46.7990	47.1393	47.8513	47.8513	48.9977	(38)
Heat transfer coeff	135.3997	134.5412	134.5412	133.3319	133.3319	131.8661	132.2169	131.5258	131.8661	132.5781	132.5781	133.7245	(39)
Average = Sum(39)m / 12 =												133.1251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3907	1.3819	1.3819	1.3695	1.3695	1.3544	1.3580	1.3509	1.3544	1.3617	1.3617	1.3735	(40)
HLP (average)												1.3673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

---

5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3400	12.9236	0.4600	0.0000	0.7700	10.7114	(75)
Southwest	9.9900	40.4699	0.4600	0.0000	0.7700	143.2011	(79)
Northwest	5.6200	12.9236	0.4600	0.0000	0.7700	25.7257	(81)
Southeast	3.3300	40.4699	0.4600	0.0000	0.7700	47.7337	(77)

```
Solar gains   227.3719   359.6683   515.9150   710.7955   821.8787   894.7964   844.4744   755.8082   623.9051   433.0593   281.3027   191.2761 (83)
Total gains   847.6087   975.2419  1107.5924  1265.2264  1337.9334  1376.5389  1306.1774  1226.3100  1115.8456   962.4717   852.4357   794.2068 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           35.8226    36.0512    36.0512    36.3781    36.3781    36.7825    36.6849    36.8777    36.7825    36.5850    36.5850    36.2713
alpha          3.3882     3.4034     3.4034     3.4252     3.4252     3.4522     3.4457     3.4585     3.4522     3.4390     3.4390     3.4181
util living area
                0.9738     0.9577     0.9197     0.8305     0.6798     0.4585     0.3098     0.3376     0.6135     0.8628     0.9530     0.9781 (86)

MIT           19.4392    19.6595    20.0445    20.4929    20.8143    20.9667    20.9938    20.9918    20.9049    20.5079    19.9218    19.4073 (87)
Th 2          19.7705    19.7772    19.7772    19.7868    19.7868    19.7985    19.7957    19.8012    19.7985    19.7928    19.7928    19.7837 (88)
util rest of house
                0.9672     0.9474     0.8998     0.7896     0.6066     0.3567     0.1914     0.2138     0.5111     0.8191     0.9394     0.9725 (89)
MIT 2         17.7616    18.0803    18.6235    19.2346    19.6255    19.7814    19.7945    19.7994    19.7358    19.2766    18.4709    17.7245 (90)
Living area fraction                                                                                             fLA = Living area / (4) =      0.2028 (91)
MIT           18.1017    18.4005    18.9116    19.4897    19.8665    20.0217    20.0376    20.0412    19.9728    19.5262    18.7651    18.0657 (92)
Temperature adjustment                                                                                                                    -0.1500
adjusted MIT  17.9517    18.2505    18.7616    19.3397    19.7165    19.8717    19.8876    19.8912    19.8228    19.3762    18.6151    17.9157 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9532     0.9298     0.8786     0.7720     0.6020     0.3632     0.2006     0.2233     0.5133     0.8006     0.9212     0.9599 (94)
Useful gains  807.9153   906.7668   973.1463   976.7426   805.4154   499.9544   261.9629   273.8282   572.7902   770.5284   785.2418   762.3923 (95)
Ext temp.       5.1000     5.6000     7.4000     9.9000    13.0000    16.0000    17.9000    17.8000    15.2000    11.6000     8.0000     5.1000 (96)
Heat loss rate W
             1740.1199  1702.0160  1528.6031  1258.6161   895.5242   510.5472   262.8003   275.0427   609.5911  1030.9577  1407.3290  1713.7745 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              693.5602   534.4075   413.2598   202.9489    67.0410     0.0000     0.0000     0.0000     0.0000   193.7594   447.9028   707.8283 (98)
Space heating                                                                                                                            3260.7079 (98)
Space heating per m2                                                                                                    (98) / (4) =     33.4912 (99)
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3602.9921	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	693.5602	534.4075	413.2598	202.9489	67.0410	0.0000	0.0000	0.0000	0.0000	193.7594	447.9028	707.8283	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000		(210)
Space heating fuel (main heating system)													
	766.3648	590.5055	456.6407	224.2529	74.0784	0.0000	0.0000	0.0000	0.0000	214.0988	494.9202	782.1308	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8363	89.7657	89.5862	89.1645	88.3337	87.3000	87.3000	87.3000	87.3000	89.0991	89.6464	89.8622	(217)
Fuel for water heating, kWh/month													
	194.8747	171.0112	177.8654	157.2693	153.4222	135.5997	127.2799	143.7432	144.7757	163.3537	175.3243	189.1545	(219)
Water heating fuel used												1933.6736	(219)
Annual totals kWh/year													
Space heating fuel - main system												3602.9921	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Total delivered energy for all uses												6008.6292	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3602.9921	3.9200	141.2373	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1933.6736	3.9200	75.8000	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	396.9635	16.9600	67.3250	(250)
Additional standing charges			88.0000	(251)
Total energy cost			385.0823	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3602.9921	0.2160	778.2463	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.6736	0.2160	417.6735	(264)
Space and water heating			1195.9198	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Total kg/year			1440.8689	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3602.9921	1.2200	4395.6504	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.6736	1.2200	2359.0818	(264)
Space and water heating			6754.7321	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)
Primary energy kWh/year			8203.6602	(272)
Primary energy kWh/m2/year			84.2611	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 30	-189 kg (13.1%)
U Solar photovoltaic panels	+ 9.4	-£ 309	-947 kg (75.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.94 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.72 kg/m²	A 94	A 95
Total Savings	£340	11.66 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£80	£89	-£8
Mains gas	£305	£266	£39
Space heating	£242	£242	£0
Water heating	£76	£45	£30
Lighting	£67	£67	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£385	£46	£340
Total cost of uses	£385	£45	£339
Delivered energy	62 kWh/m²	33 kWh/m²	28 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	84 kWh/m²	16 kWh/m²	68 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5732	0.5620	0.5507	0.4945	0.4833	0.4271	0.4271	0.4159	0.4496	0.4833	0.5058	0.5283	(22b)
Effective ac	0.6643	0.6579	0.6517	0.6223	0.6168	0.5912	0.5912	0.5865	0.6011	0.6168	0.6279	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	84.7268 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0546	54.5259	54.0076	51.5733	51.1179	48.9977	48.9977	48.6051	49.8144	51.1179	52.0393	53.0025	(38)
Heat transfer coeff	139.7814	139.2527	138.7344	136.3002	135.8447	133.7245	133.7245	133.3319	134.5412	135.8447	136.7661	137.7293	(39)
Average = Sum(39)m / 12 =												136.2980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4357	1.4303	1.4250	1.4000	1.3953	1.3735	1.3735	1.3695	1.3819	1.3953	1.4047	1.4146	(40)
HLP (average)												1.3999	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                          3.0000 (H1)
Zero-loss collector efficiency                                                                                                            0.7000 (H2)
Collector heat loss coefficient                                                                                                           1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                                 0.0050 (H3a)
Collector effective heat loss coefficient                                                                                                 1.8063 (H3b)
Collector performance ratio                                                                                                               2.5804 (H4)
Annual solar radiation per m2                                                                                                          1079.5246 (H5)
Overshading factor                                                                                                                        0.8000 (H6)
Solar energy available                                                                                                                 1813.6014 (H7)
Adjustment factor for showers                                                                                                             1.0000 (H7a)
Solar-to-load ratio                                                                                                                       1.1684 (H8)
Utilisation factor                                                                                                                        0.5751 (H9)
Collector performance factor                                                                                                              0.8793 (H10)
Dedicated solar storage volume                                                                                                           75.0000 (H11)
Effective solar volume                                                                                                                   75.0000 (H13)
Daily hot water demand                                                                                                                   98.6505 (H14)
Volume ratio Veff/V                                                                                                                       0.7603 (H15)
Solar storage volume factor                                                                                                               0.9452 (H16)
Solar input                                                                                                                            -866.7922 (H17)
Solar input    -25.1352   -41.9435   -71.4346   -95.7364  -118.2743  -116.2825  -114.7457  -100.2539   -78.5189   -53.6192   -29.8140   -21.0339 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =  -866.7922 (63)
Output from w/h
              149.9330   111.5660    87.9082    44.4919    17.2493     2.0961     0.0000    25.2339    47.8702    91.9274   127.3579   148.9444 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    854.5783 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
                76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
               620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

```
[Jan]                                        Area          Solar flux              g                FF            Access            Gains
                                             m2          Table 6a      Specific data    Specific data      factor                W
                                                           W/m2       or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                                  2.3400          11.2829            0.4600           0.0000          0.7700           9.3516 (75)
Southwest                                  9.9900          36.7938            0.4600           0.0000          0.7700         130.1934 (79)
Northwest                                  5.6200          11.2829            0.4600           0.0000          0.7700          22.4599 (81)
Southeast                                  3.3300          36.7938            0.4600           0.0000          0.7700          43.3978 (77)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    205.4027   360.4433   521.2408   692.8863   819.0297   831.9945   794.2714   697.2751   580.2281   405.9341   247.9494   174.5368 (83)
Total gains    825.6395   976.0169  1112.9182  1247.3172  1335.0844  1313.7370  1255.9743  1167.7769  1072.1685   935.3465   819.0824   777.4674 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                              21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            34.6996    34.8314    34.9615    35.5859    35.7052    36.2713    36.2713    36.3781    36.0512    35.7052    35.4647    35.2167
alpha           3.3133     3.3221     3.3308     3.3724     3.3803     3.4181     3.4181     3.4252     3.4034     3.3803     3.3643     3.3478
util living area
                0.9791     0.9634     0.9326     0.8653     0.7500     0.5897     0.4491     0.4960     0.7144     0.8997     0.9656     0.9826 (86)

MIT            19.2236    19.4828    19.8638    20.3312    20.6921    20.9042    20.9714    20.9598    20.8087    20.3290    19.6988    19.1873 (87)
Th 2           19.7361    19.7402    19.7442    19.7634    19.7670    19.7837    19.7837    19.7868    19.7772    19.7670    19.7597    19.7521 (88)
util rest of house
                0.9740     0.9546     0.9162     0.8325     0.6905     0.4979     0.3334     0.3774     0.6291     0.8676     0.9558     0.9783 (89)
MIT 2          17.4283    17.8029    18.3466    19.0032    19.4676    19.7160    19.7715    19.7680    19.6231    19.0208    18.1314    17.3859 (90)
Living area fraction                                                                                  fLA = Living area / (4) =          0.2028 (91)
MIT            17.7923    18.1435    18.6542    19.2725    19.7159    19.9569    20.0148    20.0097    19.8635    19.2860    18.4492    17.7511 (92)
Temperature adjustment                                                                                                                  -0.1500
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

adjusted MIT	17.6423	17.9935	18.5042	19.1225	19.5659	19.8069	19.8648	19.8597	19.7135	19.1360	18.2992	17.6011	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9614	0.9375	0.8950	0.8120	0.6795	0.4997	0.3414	0.3849	0.6240	0.8467	0.9394	0.9672	(94)
Useful gains	793.7644	915.0367	996.1048	1012.7951	907.2439	656.5246	428.8217	449.5021	669.0841	791.9141	769.4584	751.9762	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1865.0037	1823.3059	1665.4023	1393.3246	1068.5396	696.2965	436.5855	461.2835	755.2433	1159.5717	1531.6692	1845.7286	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	797.0021	610.3569	497.9574	273.9812	120.0041	0.0000	0.0000	0.0000	0.0000	273.5372	548.7918	813.7518	(98)
Space heating												3935.3824	(98)
Space heating per m2											(98) / (4) =	40.4209	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4348.4889	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	797.0021	610.3569	497.9574	273.9812	120.0041	0.0000	0.0000	0.0000	0.0000	273.5372	548.7918	813.7518	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	880.6653	674.4275	550.2292	302.7417	132.6012	0.0000	0.0000	0.0000	0.0000	302.2511	606.3998	899.1732	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9778	89.9902	90.0050	90.0389	90.0850	87.3000	87.3000	87.3000	87.3000	89.6732	89.8794	89.9897	(217)
Fuel for water heating, kWh/month	166.6333	123.9757	97.6704	49.4141	19.1478	2.4010	0.0000	28.9048	54.8342	102.5138	141.6986	165.5128	(219)
Water heating fuel used												952.7064	(219)
Annual totals kWh/year													
Space heating fuel - main system												4348.4889	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4095.9194	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4348.4889	3.4800	151.3274	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.7064	3.4800	33.1542	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			145.5057	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4293	(257)
SAP value	94.0115	
SAP rating (Section 12)	94	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4348.4889	0.2160	939.2736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.7064	0.2160	205.7846	(264)
Space and water heating			1145.0582	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			519.5200	(272)
CO2 emissions per m2			5.3400	(273)
EI value			95.1099	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4721	0.4496	0.4496	0.4159	0.4159	0.3709	0.3822	0.3597	0.3709	0.3934	0.3934	0.4271	(22b)
Effective ac	0.6114	0.6011	0.6011	0.5865	0.5865	0.5688	0.5730	0.5647	0.5688	0.5774	0.5774	0.5912	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6729	49.8144	49.8144	48.6051	48.6051	47.1393	47.4900	46.7990	47.1393	47.8513	47.8513	48.9977	(38)
Heat transfer coeff	135.3997	134.5412	134.5412	133.3319	133.3319	131.8661	132.2169	131.5258	131.8661	132.5781	132.5781	133.7245	(39)
Average = Sum(39)m / 12 =												133.1251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3907	1.3819	1.3819	1.3695	1.3695	1.3544	1.3580	1.3509	1.3544	1.3617	1.3617	1.3735	(40)
HLP (average)												1.3673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                          3.0000 (H1)
Zero-loss collector efficiency                                                                                                            0.7000 (H2)
Collector heat loss coefficient                                                                                                           1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                                 0.0050 (H3a)
Collector effective heat loss coefficient                                                                                                 1.8063 (H3b)
Collector performance ratio                                                                                                               2.5804 (H4)
Annual solar radiation per m2                                                                                                          1140.0998 (H5)
Overshading factor                                                                                                                        0.8000 (H6)
Solar energy available                                                                                                                 1915.3676 (H7)
Adjustment factor for showers                                                                                                             1.0000 (H7a)
Solar-to-load ratio                                                                                                                       1.2340 (H8)
Utilisation factor                                                                                                                        0.5553 (H9)
Collector performance factor                                                                                                              0.8793 (H10)
Dedicated solar storage volume                                                                                                           75.0000 (H11)
Effective solar volume                                                                                                                   75.0000 (H13)
Daily hot water demand                                                                                                                   98.6505 (H14)
Volume ratio Veff/V                                                                                                                       0.7603 (H15)
Solar storage volume factor                                                                                                               0.9452 (H16)
Solar input                                                                                                                            -883.9623 (H17)
Solar input    -27.2079   -40.8934   -68.8697   -95.1991  -114.6517  -120.6659  -117.7685  -105.1680   -82.0840   -55.8402   -33.0719   -22.5419 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =  -883.9623 (63)
Output from w/h
              147.8603   112.6160    90.4731    45.0293    20.8719     0.0000     0.0000    20.3198    44.3052    89.7064   124.1000   147.4364 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    842.7184 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
                76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
               620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

```
[Jan]                                      Area          Solar flux              g                FF            Access            Gains
                                           m2          Table 6a      Specific data    Specific data      factor                W
                                                         W/m2      or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                                2.3400          12.9236           0.4600           0.0000           0.7700           10.7114 (75)
Southwest                                9.9900          40.4699           0.4600           0.0000           0.7700          143.2011 (79)
Northwest                                5.6200          12.9236           0.4600           0.0000           0.7700           25.7257 (81)
Southeast                                3.3300          40.4699           0.4600           0.0000           0.7700           47.7337 (77)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    227.3719   359.6683   515.9150   710.7955   821.8787   894.7964   844.4744   755.8082   623.9051   433.0593   281.3027   191.2761 (83)
Total gains    847.6087   975.2419  1107.5924  1265.2264  1337.9334  1376.5389  1306.1774  1226.3100  1115.8456   962.4717   852.4357   794.2068 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                               21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            35.8226    36.0512    36.0512    36.3781    36.3781    36.7825    36.6849    36.8777    36.7825    36.5850    36.5850    36.2713
alpha           3.3882     3.4034     3.4034     3.4252     3.4252     3.4522     3.4457     3.4585     3.4522     3.4390     3.4390     3.4181
util living area
                0.9738     0.9577     0.9197     0.8305     0.6798     0.4585     0.3098     0.3376     0.6135     0.8628     0.9530     0.9781 (86)

MIT            19.4392    19.6595    20.0445    20.4929    20.8143    20.9667    20.9938    20.9918    20.9049    20.5079    19.9218    19.4073 (87)
Th 2           19.7705    19.7772    19.7772    19.7868    19.7868    19.7985    19.7957    19.8012    19.7985    19.7928    19.7928    19.7837 (88)
util rest of house
                0.9672     0.9474     0.8998     0.7896     0.6066     0.3567     0.1914     0.2138     0.5111     0.8191     0.9394     0.9725 (89)
MIT 2          17.7616    18.0803    18.6235    19.2346    19.6255    19.7814    19.7945    19.7994    19.7358    19.2766    18.4709    17.7245 (90)
Living area fraction                                                                                    fLA = Living area / (4) =          0.2028 (91)
MIT            18.1017    18.4005    18.9116    19.4897    19.8665    20.0217    20.0376    20.0412    19.9728    19.5262    18.7651    18.0657 (92)
Temperature adjustment                                                                                                                   -0.1500
```

adjusted MIT	17.9517	18.2505	18.7616	19.3397	19.7165	19.8717	19.8876	19.8912	19.8228	19.3762	18.6151	17.9157	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9532	0.9298	0.8786	0.7720	0.6020	0.3632	0.2006	0.2233	0.5133	0.8006	0.9212	0.9599	(94)
Useful gains	807.9153	906.7668	973.1463	976.7426	805.4154	499.9544	261.9629	273.8282	572.7902	770.5284	785.2418	762.3923	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1740.1199	1702.0160	1528.6031	1258.6161	895.5242	510.5472	262.8003	275.0427	609.5911	1030.9577	1407.3290	1713.7745	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	693.5602	534.4075	413.2598	202.9489	67.0410	0.0000	0.0000	0.0000	0.0000	193.7594	447.9028	707.8283	(98)
Space heating												3260.7079	(98)
Space heating per m2											(98) / (4) =	33.4912	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3602.9921	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	693.5602	534.4075	413.2598	202.9489	67.0410	0.0000	0.0000	0.0000	0.0000	193.7594	447.9028	707.8283	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	766.3648	590.5055	456.6407	224.2529	74.0784	0.0000	0.0000	0.0000	0.0000	214.0988	494.9202	782.1308	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	147.8603	112.6160	90.4731	45.0293	20.8719	0.0000	0.0000	20.3198	44.3052	89.7064	124.1000	147.4364	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9208	89.9263	89.9081	89.9016	89.7192	87.3000	87.3000	87.3000	87.3000	89.4622	89.7860	89.9317	(217)
Fuel for water heating, kWh/month	164.4339	125.2315	100.6284	50.0873	23.2635	0.0000	0.0000	23.2759	50.7505	100.2729	138.2176	163.9425	(219)
Water heating fuel used												940.1041	(219)
Annual totals kWh/year													
Space heating fuel - main system												3602.9921	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3240.9001	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3602.9921	3.9200	141.2373	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	940.1041	3.9200	36.8521	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	396.9635	16.9600	67.3250	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			45.2369	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3602.9921	0.2160	778.2463	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	940.1041	0.2160	203.0625	(264)
Space and water heating			981.3088	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			305.4690 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3602.9921	1.2200	4395.6504	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	940.1041	1.2200	1146.9270	(264)
Space and water heating			5542.5774	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1544.8354	(272)
Primary energy kWh/m2/year			15.8672	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		331.51 (P1)
Transmission heat loss coefficient		84.73 (37)
Summer heat loss coefficient		416.23 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	2.3400	98.8453	0.4600	0.0000	0.9000	95.7573
South West	9.9900	119.9223	0.4600	0.0000	0.9000	495.9820
North West	5.6200	98.8453	0.4600	0.0000	0.9000	229.9813
South East	3.3300	119.9223	0.4600	0.0000	0.9000	165.3273
total:						987.0480

	Jun	Jul	Aug	
Solar gains	1046	987	883	(P4)
Internal gains	479	459	468	
Total summer gains	1525	1446	1351	(P5)
Summer gain/loss ratio	3.66	3.47	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	20.41	22.12	21.79	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-334	**Issued on Date**	19/10/2022
Assessment Reference	Plot 334	**Prop Type Ref**	Islington-Opp-DET
Property	Plot 334, 3 Bed, K, WC, Ut, B, En		

SAP Rating	83 B	**DER**	18.01	**TER**	18.97
Environmental	85 B	**% DER<TER**	5.05		
CO_2 Emissions (t/year)	1.50	**DFEE**	53.61	**TFEE**	60.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.77		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 101 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.97 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.01 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.6 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 8.35 m², No overhang
Windows facing West: 6.36 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.028 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.4397	424.0818	408.5182	383.3957	357.7026	333.1946	317.4614	323.9879	337.0745	362.4242	391.4883	413.4617	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	528.7711	624.2635	738.1890	864.2010	946.9475	936.3916	891.7295	817.2758	720.4953	599.9568	519.0834	497.6140	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9927	0.9869	0.9721	0.9327	0.8516	0.7165	0.5747	0.6317	0.8423	0.9606	0.9882	0.9940	(86)
MIT	18.8543	19.0766	19.4782	20.0198	20.4862	20.8083	20.9330	20.9074	20.6397	20.0162	19.3492	18.8322	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9909	0.9838	0.9651	0.9145	0.8090	0.6319	0.4488	0.5080	0.7800	0.9467	0.9849	0.9926	(89)
MIT 2	16.9600	17.2860	17.8705	18.6552	19.2948	19.7038	19.8253	19.8102	19.5170	18.6654	17.6965	16.9370	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.2895	17.5975	18.1501	18.8926	19.5020	19.8959	20.0179	20.0010	19.7123	18.9004	17.9840	17.2667	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1395	17.4475	18.0001	18.7426	19.3520	19.7459	19.8679	19.8510	19.5623	18.7504	17.8340	17.1167	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9739	0.9491	0.8916	0.7868	0.6222	0.4498	0.5065	0.7602	0.9274	0.9756	0.9871	(94)
Useful gains	520.5664	607.9442	700.5954	770.5095	745.0944	582.6266	401.0594	413.9318	547.6925	556.3753	506.4159	491.2110	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1728.4830	1682.5015	1536.0757	1290.6119	999.8752	661.4492	420.0551	442.2241	706.5908	1064.9889	1412.5218	1712.2463	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	898.6899	722.1025	621.5973	374.4737	189.5569	0.0000	0.0000	0.0000	0.0000	378.4085	652.3963	908.4503	(98)
Space heating												4745.6754	(98)
Space heating per m2											(98) / (4) =	47.0895	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5243.8402	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	898.6899	722.1025	621.5973	374.4737	189.5569	0.0000	0.0000	0.0000	0.0000	378.4085	652.3963	908.4503	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	993.0276	797.9033	686.8479	413.7831	209.4551	0.0000	0.0000	0.0000	0.0000	418.1310	720.8798	1003.8125	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9591	89.9187	89.8243	89.6005	89.1323	87.3000	87.3000	87.3000	87.3000	89.5831	89.8568	89.9770	(217)
Fuel for water heating, kWh/month													
	196.0301	171.9640	178.6786	157.6293	153.1329	136.5557	128.1658	144.7599	145.8047	163.6371	176.1828	190.2893	(219)
Water heating fuel used												1942.8303	(219)
Annual totals kWh/year													
Space heating fuel - main system												5243.8402	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												7692.8531	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5243.8402	0.2160	1132.6695	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1942.8303	0.2160	419.6513	(264)
Space and water heating			1552.3208	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/year			1815.0296	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0100	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		34.9905	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.9905	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9168	(36)
Total fabric heat loss					(33) + (36) =		71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.8097	436.4559	420.9009	395.3552	368.9923	343.8168	328.0917	335.2853	349.0453	374.8182	403.8685	425.8358	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
West	6.3600	19.6403	0.6300	0.7000	0.7700	38.1748	(80)

Solar gains	88.2941	172.7220	284.4486	414.8513	508.4159	520.4541	495.4935	425.6216	330.8255	204.9493	110.0924	72.6088	(83)
Total gains	527.1038	609.1779	705.3495	810.2065	877.4082	864.2709	823.5853	760.9069	679.8708	579.7674	513.9609	498.4446	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9989	0.9976	0.9930	0.9746	0.9164	0.7805	0.6164	0.6788	0.9030	0.9875	0.9978	0.9992	(86)
MIT	19.5563	19.7053	19.9791	20.3564	20.6897	20.9083	20.9774	20.9647	20.7923	20.3524	19.8938	19.5406	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9985	0.9967	0.9902	0.9639	0.8793	0.6892	0.4797	0.5434	0.8445	0.9806	0.9968	0.9989	(89)
MIT 2	17.9545	18.1746	18.5762	19.1306	19.5887	19.8557	19.9115	19.9073	19.7351	19.1331	18.4619	17.9409	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2331	18.4409	18.8202	19.3438	19.7803	20.0388	20.0969	20.0912	19.9190	19.3452	18.7110	18.2191	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2331	18.4409	18.8202	19.3438	19.7803	20.0388	20.0969	20.0912	19.9190	19.3452	18.7110	18.2191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9949	0.9864	0.9565	0.8741	0.7005	0.5034	0.5664	0.8448	0.9754	0.9952	0.9981	(94)
Useful gains	525.8160	606.0792	695.7545	774.9516	766.9001	605.4357	414.6235	430.9559	574.3655	565.5077	511.5045	497.5164	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1755.3643	1699.9624	1541.3817	1285.3812	991.4067	657.6727	422.8568	445.1462	707.6234	1072.9912	1433.5504	1742.1565	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	914.7840	735.0895	629.1466	367.5093	167.0329	0.0000	0.0000	0.0000	0.0000	377.5677	663.8731	926.0122	(98)
Space heating												4781.0153	(98)
Space heating per m2											(98) / (4) =	47.4401	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5118.8601	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	914.7840	735.0895	629.1466	367.5093	167.0329	0.0000	0.0000	0.0000	0.0000	377.5677	663.8731	926.0122	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	979.4261	787.0337	673.6045	393.4789	178.8361	0.0000	0.0000	0.0000	0.0000	404.2481	710.7849	991.4478	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3011	88.1431	87.7642	86.8663	85.0056	80.3000	80.3000	80.3000	80.3000	86.8285	87.9001	88.3612	(217)
Fuel for water heating, kWh/month													
	241.4012	213.1640	224.8615	202.2417	200.0917	186.5567	178.7355	199.2482	201.4487	211.3080	220.6679	235.4450	(219)
Water heating fuel used												2515.1700	(219)
Annual totals kWh/year													
Space heating fuel - main system												5118.8601	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												8140.2126	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5118.8601	0.2160	1105.6738	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.1700	0.2160	543.2767	(264)
Space and water heating			1648.9505	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total CO2, kg/m2/year			1911.6592	(272)
Emissions per m2 for space and water heating			16.3619	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2205	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3619 * 1.00) + 2.2205 + 0.3862, rounded to 2 d.p.			18.9700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4040	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4040	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5152	0.5051	0.4950	0.4444	0.4343	0.3838	0.3838	0.3737	0.4040	0.4343	0.4545	0.4747	(22b)
Effective ac	0.6327	0.6275	0.6225	0.5988	0.5943	0.5737	0.5737	0.5698	0.5816	0.5943	0.6033	0.6127	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3927	53.9497	53.5155	51.4761	51.0946	49.3183	49.3183	48.9894	50.0025	51.0946	51.8665	52.6735	(38)
Heat transfer coeff	132.3518	131.9088	131.4746	129.4352	129.0536	127.2774	127.2774	126.9484	127.9615	129.0536	129.8255	130.6325	(39)
Average = Sum(39)m / 12 =												129.4334	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3133	1.3089	1.3046	1.2843	1.2805	1.2629	1.2629	1.2597	1.2697	1.2805	1.2882	1.2962	(40)
HLP (average)												1.2843	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	494.8563	591.1819	706.8374	835.2039	919.4811	911.0781	868.2425	791.4449	693.8290	570.8537	487.2316	464.5288	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.7887	33.9022	34.0142	34.5501	34.6523	35.1359	35.1359	35.2269	34.9480	34.6523	34.4462	34.2334	
alpha	3.2526	3.2601	3.2676	3.3033	3.3102	3.3424	3.3424	3.3485	3.3299	3.3102	3.2964	3.2822	
util living area													
	0.9940	0.9888	0.9750	0.9373	0.8582	0.7249	0.5829	0.6426	0.8518	0.9652	0.9902	0.9952	(86)
MIT	18.8486	19.0709	19.4729	20.0123	20.4812	20.8046	20.9316	20.9043	20.6306	20.0015	19.3345	18.8221	(87)
Th 2	19.8305	19.8339	19.8373	19.8531	19.8561	19.8700	19.8700	19.8726	19.8646	19.8561	19.8501	19.8438	(88)
util rest of house													
	0.9926	0.9861	0.9687	0.9203	0.8170	0.6413	0.4571	0.5193	0.7920	0.9527	0.9874	0.9940	(89)
MIT 2	17.8720	18.0956	18.4963	19.0347	19.4757	19.7604	19.8455	19.8347	19.6266	19.0349	18.3710	17.8551	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.0419	18.2652	18.6662	19.2047	19.6506	19.9421	20.0344	20.0207	19.8012	19.2030	18.5386	18.0233	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0419	18.2652	18.6662	19.2047	19.6506	19.9421	20.0344	20.0207	19.8012	19.2030	18.5386	18.0233	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9894	0.9810	0.9601	0.9081	0.8082	0.6473	0.4769	0.5372	0.7880	0.9430	0.9828	0.9914	(94)
Useful gains	489.6130	579.9243	678.6142	758.4553	743.1192	589.7574	414.0513	425.1648	546.7049	538.3342	478.8521	460.5129	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1818.7626	1762.9933	1599.5414	1333.7939	1026.0550	679.9221	437.1206	459.6468	729.5356	1110.2533	1485.0186	1805.7706	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	988.8873	795.0224	685.1699	414.2438	210.5043	0.0000	0.0000	0.0000	0.0000	425.5078	724.4399	1000.8717	(98)
Space heating												5244.6470	(98)
Space heating per m2											(98) / (4) =	52.0406	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1196.4072	941.8525	964.8080	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7614	0.8310	0.7949	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	910.9344	782.6962	766.9261	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1171.0257	1118.7261	1031.0348	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	187.2657	250.0063	196.4968	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												633.7689	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.8164	62.5016	49.1242	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												158.4422	(107)
Space cooling per m2												1.5722	(108)
Energy for space heating												52.0406	(99)
Energy for space cooling												1.5722	(108)
Total												53.6127	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1535	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4035	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4035	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			14.7100	1.3258	19.5019			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.1800	23.4144			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.7037			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9168	(36)
Total fabric heat loss (33) + (36) =	71.6205	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	125.9850	125.5431	125.1100	123.0756	122.6950	120.9231	120.9231	120.5950	121.6056	122.6950	123.4650	124.2700	(39)
Average = Sum(39)m / 12 =												123.0738	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2501	1.2457	1.2414	1.2212	1.2175	1.1999	1.1999	1.1966	1.2066	1.2175	1.2251	1.2331	(40)
HLP (average)												1.2212	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.4153	21.6855	17.6358	13.3515	9.9804	8.4258	9.1044	11.8343	15.8839	20.1683	23.5394	25.0939	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.5250	391.0001	377.1665	354.3987	330.2362	307.8810	293.9744	298.1570	310.4082	333.3212	359.6365	380.3765	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
West	6.3600	19.6403	0.6300	0.7000	0.7700	38.1748	(80)

Solar gains	88.2941	172.7220	284.4486	414.8513	508.4159	520.4541	495.4935	425.6216	330.8255	204.9493	110.0924	72.6088	(83)
Total gains	480.8191	563.7221	661.6151	769.2500	838.6521	828.3352	789.4679	723.7787	641.2337	538.2705	469.7289	452.9853	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5512	55.7467	55.9397	56.8643	57.0407	57.8765	57.8765	58.0340	57.5517	57.0407	56.6850	56.3178	
alpha	4.7034	4.7164	4.7293	4.7910	4.8027	4.8584	4.8584	4.8689	4.8368	4.8027	4.7790	4.7545	
util living area													
	0.9993	0.9983	0.9946	0.9791	0.9274	0.7999	0.6381	0.7044	0.9189	0.9908	0.9985	0.9995	(86)
MIT	19.5142	19.6641	19.9403	20.3229	20.6656	20.8972	20.9739	20.9585	20.7695	20.3163	19.8535	19.4991	(87)
Th 2	19.8801	19.8836	19.8870	19.9031	19.9061	19.9201	19.9201	19.9227	19.9147	19.9061	19.9000	19.8936	(88)
util rest of house													
	0.9990	0.9976	0.9925	0.9701	0.8938	0.7109	0.4990	0.5680	0.8665	0.9855	0.9979	0.9993	(89)
MIT 2	18.5233	18.6758	18.9537	19.3438	19.6692	19.8698	19.9131	19.9100	19.7750	19.3433	18.8780	18.5188	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.6957	18.8477	19.1253	19.5141	19.8425	20.0485	20.0977	20.0924	19.9480	19.5125	19.0477	18.6893	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6957	18.8477	19.1253	19.5141	19.8425	20.0485	20.0977	20.0924	19.9480	19.5125	19.0477	18.6893	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9968	0.9905	0.9659	0.8914	0.7229	0.5234	0.5916	0.8686	0.9828	0.9971	0.9989	(94)
Useful gains	480.1327	561.8965	655.2980	743.0131	747.5588	598.8209	413.2298	428.2053	556.9461	529.0359	468.3772	452.5058	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1813.6375	1751.0353	1579.5521	1306.3348	999.0486	658.8514	422.9471	445.2865	711.1477	1093.5235	1475.1246	1800.5898	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	992.1276	799.1013	687.6451	405.5916	187.1084	0.0000	0.0000	0.0000	0.0000	419.9788	724.8581	1002.9745	(98)
Space heating												5219.3853	(98)
Space heating per m2											(98) / (4) =	51.7899	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1136.6775	894.8312	916.5221	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8051	0.8809	0.8449	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	915.1290	788.2565	774.4131	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1074.3132	1026.6519	951.9444	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	114.6126	177.3662	132.0833	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												424.0621	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	28.6532	44.3415	33.0208	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												106.0155 (107)
Space cooling per m2												1.0519 (108)
Energy for space heating												51.7899 (99)
Energy for space cooling												1.0519 (108)
Total												52.8418 (109)
Target Fabric Energy Efficiency (TFEE)												60.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	22.3313	0.4600	0.0000	0.7700	39.7070	(76)
West	6.3600	22.3313	0.4600	0.0000	0.7700	50.3060	(80)
East	3.3300	22.3313	0.4600	0.0000	0.7700	26.3395	(76)

Solar gains	116.3525	204.7390	332.4600	498.2622	593.7004	649.9137	612.2450	538.6304	418.6576	259.2540	148.6260	94.7542	(83)
Total gains	751.2438	834.4941	937.2595	1064.4499	1120.2231	1141.2174	1083.2356	1018.9258	921.4316	800.8671	733.2750	712.0876	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9770	0.9664	0.9375	0.8658	0.7337	0.5178	0.3556	0.3858	0.6767	0.8953	0.9622	0.9801	(86)
MIT	19.3180	19.5048	19.8895	20.3665	20.7429	20.9462	20.9891	20.9859	20.8589	20.3912	19.7956	19.2993	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9717	0.9588	0.9227	0.8333	0.6688	0.4152	0.2299	0.2556	0.5816	0.8620	0.9520	0.9755	(89)
MIT 2	17.6529	17.9258	18.4754	19.1412	19.6219	19.8432	19.8693	19.8736	19.7702	19.1954	18.3585	17.6343	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9425	18.2005	18.7214	19.3543	19.8169	20.0351	20.0641	20.0671	19.9596	19.4034	18.6085	17.9239	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7925	18.0505	18.5714	19.2043	19.6669	19.8851	19.9141	19.9171	19.8096	19.2534	18.4585	17.7739	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9578	0.9417	0.9006	0.8104	0.6562	0.4162	0.2347	0.2603	0.5754	0.8388	0.9339	0.9629	(94)
Useful gains	719.5402	785.8454	844.0506	862.6413	735.0684	475.0175	254.2745	265.2392	530.2122	671.7569	684.7841	685.6469	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1652.8284	1610.5706	1445.1060	1192.2893	854.3232	492.1286	255.8375	267.4497	583.8977	974.9391	1332.2658	1629.0809	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.3664	554.2153	447.1852	237.3465	88.7255	0.0000	0.0000	0.0000	0.0000	225.5676	466.1868	701.9149	(98)
Space heating												3415.5083	(98)
RHI space heating demand												3416	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4424	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	737.2227	829.9369	934.4703	1046.9931	1115.7676	1094.5007	1045.2588	973.5833	886.1949	779.1455	712.2441	701.4857	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9812	0.9712	0.9486	0.8950	0.7980	0.6495	0.5063	0.5547	0.7704	0.9242	0.9714	0.9838	(86)
MIT	19.1014	19.3135	19.6889	20.1844	20.5917	20.8588	20.9541	20.9374	20.7354	20.1969	19.5736	19.0768	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9770	0.9648	0.9366	0.8697	0.7480	0.5632	0.3891	0.4370	0.6968	0.9006	0.9639	0.9802	(89)
MIT 2	17.3179	17.6267	18.1681	18.8764	19.4209	19.7497	19.8373	19.8293	19.6196	18.9116	18.0186	17.2920	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6281	17.9201	18.4327	19.1039	19.6245	19.9426	20.0316	20.0220	19.8137	19.1352	18.2891	17.6024	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4781	17.7701	18.2827	18.9539	19.4745	19.7926	19.8816	19.8720	19.6637	18.9852	18.1391	17.4524	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9644	0.9486	0.9153	0.8455	0.7293	0.5576	0.3915	0.4380	0.6825	0.8771	0.9478	0.9689	(94)
Useful gains	710.9654	787.3134	855.3427	885.2281	813.7421	610.2635	409.1836	426.4414	604.8284	683.3649	675.0553	679.6994	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1774.0674	1725.7677	1573.8156	1318.3225	1015.8798	667.4426	421.8071	444.9203	719.7082	1095.6702	1452.6655	1756.7532	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	790.9479	630.6413	534.5438	311.8280	150.3905	0.0000	0.0000	0.0000	0.0000	306.7551	559.8793	801.3281	(98)
Space heating												4086.3140	(98)
Space heating per m2											(98) / (4) =	40.5469	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4515.2640	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	790.9479	630.6413	534.5438	311.8280	150.3905	0.0000	0.0000	0.0000	0.0000	306.7551	559.8793	801.3281	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	873.9756	696.8412	590.6562	344.5613	166.1774	0.0000	0.0000	0.0000	0.0000	338.9559	618.6512	885.4454	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8992	89.8515	89.7404	89.4776	88.9488	87.3000	87.3000	87.3000	87.3000	89.4399	89.7746	89.9197	(217)
Fuel for water heating, kWh/month													
	196.1606	172.0927	178.8457	157.8459	153.4489	136.5557	128.1658	144.7599	145.8047	163.8992	176.3441	190.4105	(219)
Water heating fuel used												1944.3336	(219)
Annual totals kWh/year													
Space heating fuel - main system												4515.2640	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6965.7802	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4515.2640	3.4800	157.1312	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.3336	3.4800	67.6628	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Total energy cost			411.5595	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1857	(257)
SAP value		83.4591	
SAP rating (Section 12)		83	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4515.2640	0.2160	975.2970	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.3336	0.2160	419.9761	(264)
Space and water heating			1395.2731	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1657.9818	(272)
CO2 emissions per m2			16.4500	(273)
EI value			84.7599	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	22.3313	0.4600	0.0000	0.7700	39.7070	(76)
West	6.3600	22.3313	0.4600	0.0000	0.7700	50.3060	(80)
East	3.3300	22.3313	0.4600	0.0000	0.7700	26.3395	(76)

Solar gains	116.3525	204.7390	332.4600	498.2622	593.7004	649.9137	612.2450	538.6304	418.6576	259.2540	148.6260	94.7542	(83)
Total gains	751.2438	834.4941	937.2595	1064.4499	1120.2231	1141.2174	1083.2356	1018.9258	921.4316	800.8671	733.2750	712.0876	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9770	0.9664	0.9375	0.8658	0.7337	0.5178	0.3556	0.3858	0.6767	0.8953	0.9622	0.9801	(86)
MIT	19.3180	19.5048	19.8895	20.3665	20.7429	20.9462	20.9891	20.9859	20.8589	20.3912	19.7956	19.2993	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9717	0.9588	0.9227	0.8333	0.6688	0.4152	0.2299	0.2556	0.5816	0.8620	0.9520	0.9755	(89)
MIT 2	17.6529	17.9258	18.4754	19.1412	19.6219	19.8432	19.8693	19.8736	19.7702	19.1954	18.3585	17.6343	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9425	18.2005	18.7214	19.3543	19.8169	20.0351	20.0641	20.0671	19.9596	19.4034	18.6085	17.9239	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7925	18.0505	18.5714	19.2043	19.6669	19.8851	19.9141	19.9171	19.8096	19.2534	18.4585	17.7739	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9578	0.9417	0.9006	0.8104	0.6562	0.4162	0.2347	0.2603	0.5754	0.8388	0.9339	0.9629	(94)
Useful gains	719.5402	785.8454	844.0506	862.6413	735.0684	475.0175	254.2745	265.2392	530.2122	671.7569	684.7841	685.6469	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1652.8284	1610.5706	1445.1060	1192.2893	854.3232	492.1286	255.8375	267.4497	583.8977	974.9391	1332.2658	1629.0809	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.3664	554.2153	447.1852	237.3465	88.7255	0.0000	0.0000	0.0000	0.0000	225.5676	466.1868	701.9149	(98)
Space heating												3415.5083	(98)
Space heating per m2											(98) / (4) =	33.8907	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3774.0423	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	694.3664	554.2153	447.1852	237.3465	88.7255	0.0000	0.0000	0.0000	0.0000	225.5676	466.1868	701.9149	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	767.2557	612.3926	494.1273	262.2614	98.0393	0.0000	0.0000	0.0000	0.0000	249.2459	515.1236	775.5966	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8331	89.7821	89.6323	89.2791	88.5333	87.3000	87.3000	87.3000	87.3000	89.2119	89.6668	89.8541	(217)
Fuel for water heating, kWh/month													
	196.3050	172.2256	179.0614	158.1968	154.1690	136.5557	128.1658	144.7599	145.8047	164.3180	176.5562	190.5495	(219)
Water heating fuel used												1946.6677	(219)
Annual totals kWh/year													
Space heating fuel - main system												3774.0423	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Total delivered energy for all uses												6226.8926	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3774.0423	3.9200	147.9425	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.6677	3.9200	76.3094	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Total energy cost			398.1004	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3774.0423	0.2160	815.1931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.6677	0.2160	420.4802	(264)
Space and water heating			1235.6734	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Total kg/year			1498.3821	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3774.0423	1.2200	4604.3317	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.6677	1.2200	2374.9346	(264)
Space and water heating			6979.2662	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Primary energy kWh/year			8533.2467	(272)
Primary energy kWh/m2/year			84.6720	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 83
Current environmental impact rating:	B 85

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-189 kg (12.6%)
U Solar photovoltaic panels	+ 9.2	-£ 309	-947 kg (72.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	1.88 kg/m²	B 85	B 86
Solar photovoltaic panels	£309	9.39 kg/m²	A 94	A 95
Total Savings	£340	11.27 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£86	£94	-£8
Mains gas	£312	£273	£39
Space heating	£249	£249	£0
Water heating	£76	£46	£31
Lighting	£73	£73	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£398	£58	£340
Total cost of uses	£398	£59	£340
Delivered energy	62 kWh/m²	34 kWh/m²	28 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	4 kg/m²	11 kg/m²
Primary energy	85 kWh/m²	19 kWh/m²	66 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5641	0.5530	0.5420	0.4867	0.4756	0.4203	0.4203	0.4092	0.4424	0.4756	0.4977	0.5199	(22b)
Effective ac	0.6591	0.6529	0.6469	0.6184	0.6131	0.5883	0.5883	0.5837	0.5979	0.6131	0.6239	0.6351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	56.6632	56.1320	55.6114	53.1661	52.7086	50.5788	50.5788	50.1844	51.3992	52.7086	53.6341	54.6017	(38)
Heat transfer coeff	134.6222	134.0911	133.5705	131.1252	130.6676	128.5379	128.5379	128.1435	129.3582	130.6676	131.5932	132.5608	(39)
Average = Sum(39)m / 12 =												131.1230	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3305	1.3254	1.3011	1.2966	1.2754	1.2754	1.2715	1.2836	1.2966	1.3057	1.3153	(40)
HLP (average)												1.3011	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	19.6403	0.4600	0.0000	0.7700	34.9220	(76)
West	6.3600	19.6403	0.4600	0.0000	0.7700	44.2439	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	102.3313	200.1818	329.6708	480.8053	589.2449	603.1970	574.2681	493.2878	383.4208	237.5325	127.5951	84.1523	(83)
Total gains	737.2227	829.9369	934.4703	1046.9931	1115.7676	1094.5007	1045.2588	973.5833	886.1949	779.1455	712.2441	701.4857	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2189	33.3505	33.4804	34.1048	34.2242	34.7913	34.7913	34.8984	34.5707	34.2242	33.9835	33.7355	
alpha	3.2146	3.2234	3.2320	3.2737	3.2816	3.3194	3.3194	3.3266	3.3047	3.2816	3.2656	3.2490	
util living area													
	0.9812	0.9712	0.9486	0.8950	0.7980	0.6495	0.5063	0.5547	0.7704	0.9242	0.9714	0.9838	(86)
MIT	19.1014	19.3135	19.6889	20.1844	20.5917	20.8588	20.9541	20.9374	20.7354	20.1969	19.5736	19.0768	(87)
Th 2	19.8129	19.8170	19.8210	19.8400	19.8435	19.8601	19.8601	19.8632	19.8537	19.8435	19.8363	19.8288	(88)
util rest of house													
	0.9770	0.9648	0.9366	0.8697	0.7480	0.5632	0.3891	0.4370	0.6968	0.9006	0.9639	0.9802	(89)
MIT 2	17.3179	17.6267	18.1681	18.8764	19.4209	19.7497	19.8373	19.8293	19.6196	18.9116	18.0186	17.2920	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.6281	17.9201	18.4327	19.1039	19.6245	19.9426	20.0316	20.0220	19.8137	19.1352	18.2891	17.6024	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4781	17.7701	18.2827	18.9539	19.4745	19.7926	19.8816	19.8720	19.6637	18.9852	18.1391	17.4524	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9644	0.9486	0.9153	0.8455	0.7293	0.5576	0.3915	0.4380	0.6825	0.8771	0.9478	0.9689	(94)
Useful gains	710.9654	787.3134	855.3427	885.2281	813.7421	610.2635	409.1836	426.4414	604.8284	683.3649	675.0553	679.6994	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1774.0674	1725.7677	1573.8156	1318.3225	1015.8798	667.4426	421.8071	444.9203	719.7082	1095.6702	1452.6655	1756.7532	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	790.9479	630.6413	534.5438	311.8280	150.3905	0.0000	0.0000	0.0000	0.0000	306.7551	559.8793	801.3281	(98)
Space heating												4086.3140	(98)
Space heating per m2											(98) / (4) =	40.5469	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4515.2640	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	790.9479	630.6413	534.5438	311.8280	150.3905	0.0000	0.0000	0.0000	0.0000	306.7551	559.8793	801.3281	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	873.9756	696.8412	590.6562	344.5613	166.1774	0.0000	0.0000	0.0000	0.0000	338.9559	618.6512	885.4454	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9709	90.0004	90.0298	90.0821	90.1499	87.3000	87.3000	87.3000	87.3000	89.7361	89.8854	89.9796	(217)
Fuel for water heating, kWh/month	167.9745	125.0496	98.6622	50.1573	19.7719	2.9152	0.0000	29.5406	55.5649	103.4080	142.8479	166.8299	(219)
Water heating fuel used												962.7220	(219)
Annual totals kWh/year													
Space heating fuel - main system												4515.2640	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4306.9292	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4515.2640	3.4800	157.1312	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.7220	3.4800	33.5027	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	431.1826	13.1900	56.8730	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			156.1715	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4499	(257)
SAP value	93.7234	
SAP rating (Section 12)	94	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4515.2640	0.2160	975.2970	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.7220	0.2160	207.9480	(264)
Space and water heating			1183.2450	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			575.4665	(272)
CO2 emissions per m2			5.7100	(273)
EI value			94.7104	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4424	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4424	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4645	0.4424	0.4424	0.4092	0.4092	0.3650	0.3761	0.3539	0.3650	0.3871	0.3871	0.4203	(22b)
Effective ac	0.6079	0.5979	0.5979	0.5837	0.5837	0.5666	0.5707	0.5626	0.5666	0.5749	0.5749	0.5883	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	18.9700	130.0800	0.2500	32.5200	52.3000	6803.1840	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.0619			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16099.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.7459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8972 (36)
Total fabric heat loss	(33) + (36) =	77.9591 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.2616	51.3992	51.3992	50.1844	50.1844	48.7120	49.0643	48.3701	48.7120	49.4271	49.4271	50.5788	(38)
Heat transfer coeff	130.2207	129.3582	129.3582	128.1435	128.1435	126.6710	127.0233	126.3292	126.6710	127.3862	127.3862	128.5379	(39)
Average = Sum(39)m / 12 =												127.9357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2921	1.2836	1.2836	1.2715	1.2715	1.2569	1.2604	1.2535	1.2569	1.2640	1.2640	1.2754	(40)
HLP (average)												1.2695	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2243	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-887.0104	(H17)
Solar input	-27.3017	-41.0345	-69.1072	-95.5273	-115.0470	-121.0820	-118.1746	-105.5306	-82.3670	-56.0328	-33.1860	-22.6197	(63)
								Solar input (sum of months) = Sum(63)m =				-887.0104	(63)
Output from w/h													
	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
								Total per year (kWh/year) = Sum(64)m =				851.2283	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.0384	54.2137	44.0896	33.3786	24.9509	21.0646	22.7611	29.5857	39.7099	50.4208	58.8485	62.7348	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	634.8914	629.7551	604.7995	566.1878	526.5227	491.3037	470.9906	480.2954	502.7741	541.6130	584.6490	617.3334	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0200	22.3313	0.4600	0.0000	0.7700	39.7070	(76)
West	6.3600	22.3313	0.4600	0.0000	0.7700	50.3060	(80)
East	3.3300	22.3313	0.4600	0.0000	0.7700	26.3395	(76)

Solar gains	116.3525	204.7390	332.4600	498.2622	593.7004	649.9137	612.2450	538.6304	418.6576	259.2540	148.6260	94.7542	(83)
Total gains	751.2438	834.4941	937.2595	1064.4499	1120.2231	1141.2174	1083.2356	1018.9258	921.4316	800.8671	733.2750	712.0876	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3417	34.5707	34.5707	34.8984	34.8984	35.3040	35.2061	35.3996	35.3040	35.1058	35.1058	34.7913	
alpha	3.2894	3.3047	3.3047	3.3266	3.3266	3.3536	3.3471	3.3600	3.3536	3.3404	3.3404	3.3194	
util living area													
	0.9770	0.9664	0.9375	0.8658	0.7337	0.5178	0.3556	0.3858	0.6767	0.8953	0.9622	0.9801	(86)
MIT	19.3180	19.5048	19.8895	20.3665	20.7429	20.9462	20.9891	20.9859	20.8589	20.3912	19.7956	19.2993	(87)
Th 2	19.8470	19.8537	19.8537	19.8632	19.8632	19.8747	19.8720	19.8774	19.8747	19.8691	19.8691	19.8601	(88)
util rest of house													
	0.9717	0.9588	0.9227	0.8333	0.6688	0.4152	0.2299	0.2556	0.5816	0.8620	0.9520	0.9755	(89)
MIT 2	17.6529	17.9258	18.4754	19.1412	19.6219	19.8432	19.8693	19.8736	19.7702	19.1954	18.3585	17.6343	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.9425	18.2005	18.7214	19.3543	19.8169	20.0351	20.0641	20.0671	19.9596	19.4034	18.6085	17.9239	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7925	18.0505	18.5714	19.2043	19.6669	19.8851	19.9141	19.9171	19.8096	19.2534	18.4585	17.7739	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9578	0.9417	0.9006	0.8104	0.6562	0.4162	0.2347	0.2603	0.5754	0.8388	0.9339	0.9629	(94)
Useful gains	719.5402	785.8454	844.0506	862.6413	735.0684	475.0175	254.2745	265.2392	530.2122	671.7569	684.7841	685.6469	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1652.8284	1610.5706	1445.1060	1192.2893	854.3232	492.1286	255.8375	267.4497	583.8977	974.9391	1332.2658	1629.0809	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	694.3664	554.2153	447.1852	237.3465	88.7255	0.0000	0.0000	0.0000	0.0000	225.5676	466.1868	701.9149	(98)
Space heating												3415.5083	(98)
Space heating per m2											(98) / (4) =	33.8907	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3774.0423	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	694.3664	554.2153	447.1852	237.3465	88.7255	0.0000	0.0000	0.0000	0.0000	225.5676	466.1868	701.9149	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	767.2557	612.3926	494.1273	262.2614	98.0393	0.0000	0.0000	0.0000	0.0000	249.2459	515.1236	775.5966	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.0451	113.5933	91.3896	45.7094	21.4439	0.0000	0.0000	20.8448	44.9205	90.5585	125.1263	148.5969	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9176	89.9392	89.9406	89.9675	89.8589	87.3000	87.3000	87.3000	87.3000	89.5596	89.8034	89.9241	(217)
Fuel for water heating, kWh/month	165.7575	126.3001	101.6111	50.8065	23.8639	0.0000	0.0000	23.8772	51.4554	101.1154	139.3335	165.2470	(219)
Water heating fuel used												949.3677	(219)

Annual totals kWh/year		
Space heating fuel - main system	3774.0423	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	431.1826	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	3455.4330	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3774.0423	3.9200	147.9425	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	949.3677	3.9200	37.2152	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	431.1826	16.9600	73.1286	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			58.1088	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3774.0423	0.2160	815.1931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.3677	0.2160	205.0634	(264)
Space and water heating			1020.2566	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	431.1826	0.5190	223.7837	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			362.1765	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3774.0423	1.2200	4604.3317	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	949.3677	1.2200	1158.2286	(264)
Space and water heating			5762.5602	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	431.1826	3.0700	1323.7305	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1869.8706	(272)
Primary energy kWh/m2/year			18.5540	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	159.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	343.88	(P1)
Transmission heat loss coefficient	77.96	(37)
Summer heat loss coefficient	421.84	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	5.0200	117.5071	0.4600	0.0000	0.9000	244.2126
West	6.3600	117.5071	0.4600	0.0000	0.9000	309.4008
East	3.3300	117.5071	0.4600	0.0000	0.9000	161.9976
total:						715.6110

	Jun	Jul	Aug	
Solar gains	760	716	630	(P4)
Internal gains	488	468	477	
Total summer gains	1248	1184	1107	(P5)
Summer gain/loss ratio	2.96	2.81	2.62	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.7)	0.88	0.88	0.88	
Threshold temperature	19.84	21.59	21.31	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-335	**Issued on Date**	19/10/2022
Assessment Reference	Plot 335	**Prop Type Ref**	Maplethorne-As-DET
Property	Plot 335, 3 Bed, K, WC, B, En		

SAP Rating	83 B	**DER**	18.01	**TER**	18.91
Environmental	85 B	**% DER<TER**	4.75		
CO_2 Emissions (t/year)	1.42	**DFEE**	52.40	**TFEE**	58.99
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.18		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.91 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.01 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.64 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 5.06 m², No overhang
Windows facing North West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.4122	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487	(83)
Total gains	524.3049	609.5632	696.1878	792.4241	862.8713	855.1620	812.5483	744.7959	668.1159	578.2939	513.9022	494.7120	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9931	0.9878	0.9757	0.9427	0.8686	0.7361	0.5935	0.6516	0.8547	0.9629	0.9886	0.9943	(86)
MIT	18.9926	19.1989	19.5583	20.0524	20.4999	20.8148	20.9363	20.9110	20.6567	20.0807	19.4586	18.9679	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9914	0.9848	0.9692	0.9263	0.8281	0.6516	0.4651	0.5262	0.7939	0.9492	0.9853	0.9929	(89)
MIT 2	17.1612	17.4636	17.9871	18.7046	19.3206	19.7199	19.8375	19.8225	19.5446	18.7574	17.8540	17.1334	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.4398	17.7276	18.2261	18.9096	19.5000	19.8865	20.0047	19.9881	19.7138	18.9587	18.0981	17.4125	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2898	17.5776	18.0761	18.7596	19.3500	19.7365	19.8547	19.8381	19.5638	18.8087	17.9481	17.2625	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9853	0.9756	0.9548	0.9051	0.8059	0.6401	0.4632	0.5219	0.7735	0.9308	0.9764	0.9878	(94)
Useful gains	516.5931	594.6933	664.7371	717.2473	695.4040	547.3831	376.3951	388.6772	516.7580	538.2903	501.7836	488.6734	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1635.1782	1590.3266	1447.1867	1212.7264	938.0561	620.8307	393.3806	414.4286	664.0823	1006.5650	1338.4932	1622.1333	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	832.2273	669.0655	582.1426	356.7450	180.5331	0.0000	0.0000	0.0000	0.0000	348.3963	602.4309	843.2942	(98)
Space heating												4414.8350	(98)
Space heating per m2											(98) / (4) =	46.1272	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4878.2708	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	832.2273	669.0655	582.1426	356.7450	180.5331	0.0000	0.0000	0.0000	0.0000	348.3963	602.4309	843.2942	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	919.5882	739.2989	643.2514	394.1934	199.4841	0.0000	0.0000	0.0000	0.0000	384.9683	665.6696	931.8168	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9289	89.8871	89.7948	89.5761	89.1026	87.3000	87.3000	87.3000	87.3000	89.5356	89.8209	89.9487	(217)
Fuel for water heating, kWh/month													
	193.9139	170.1153	176.7651	155.9449	151.5180	135.0886	126.8064	143.1997	144.2255	161.9336	174.3052	188.2366	(219)
Water heating fuel used												1922.0527	(219)
Annual totals kWh/year													
Space heating fuel - main system												4878.2708	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7291.4029	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4878.2708	0.2160	1053.7065	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.0527	0.2160	415.1634	(264)
Space and water heating			1468.8699	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/year			1723.7401	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0100	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		35.3584	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.3584	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	93.8213	169.3875	257.1968	361.3096	443.6078	457.5155	433.9710	369.9562	292.8388	194.0668	114.1200	79.1631	(83)
Total gains	521.7605	595.0093	667.6822	746.7429	803.4444	792.8644	754.0017	697.0857	633.3314	559.8359	508.1408	494.5022	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9987	0.9972	0.9930	0.9769	0.9235	0.7923	0.6299	0.6923	0.9064	0.9865	0.9974	0.9990	(86)
MIT	19.6045	19.7474	20.0006	20.3539	20.6822	20.9042	20.9761	20.9626	20.7926	20.3748	19.9324	19.5857	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9982	0.9963	0.9903	0.9670	0.8888	0.7030	0.4929	0.5574	0.8494	0.9791	0.9963	0.9986	(89)
MIT 2	18.0367	18.2476	18.6187	19.1377	19.5910	19.8630	19.9220	19.9169	19.7460	19.1746	18.5281	18.0172	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2752	18.4757	18.8289	19.3227	19.7570	20.0214	20.0823	20.0760	19.9053	19.3572	18.7417	18.2558	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2752	18.4757	18.8289	19.3227	19.7570	20.0214	20.0823	20.0760	19.9053	19.3572	18.7417	18.2558	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9943	0.9864	0.9597	0.8823	0.7115	0.5135	0.5771	0.8480	0.9734	0.9944	0.9978	(94)
Useful gains	520.2596	591.6178	658.5898	716.6269	708.8999	564.1454	387.1733	402.3037	537.0570	544.9571	505.2747	493.4047	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1643.1860	1591.3910	1440.9427	1201.1078	926.0214	615.3823	395.2766	416.2898	662.1369	1006.4960	1345.2364	1633.2807	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	835.4572	671.8476	582.0706	348.8262	161.5384	0.0000	0.0000	0.0000	0.0000	343.3849	604.7724	848.0678	(98)
Space heating												4395.9651	(98)
Space heating per m2											(98) / (4) =	45.9301	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4706.6008	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	835.4572	671.8476	582.0706	348.8262	161.5384	0.0000	0.0000	0.0000	0.0000	343.3849	604.7724	848.0678	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	894.4938	719.3229	623.2019	373.4756	172.9533	0.0000	0.0000	0.0000	0.0000	367.6498	647.5079	907.9955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1624	87.9984	87.6280	86.7738	84.9521	80.3000	80.3000	80.3000	80.3000	86.6272	87.7384	88.2300	(217)
Fuel for water heating, kWh/month													
	239.5607	211.5692	223.1948	200.0140	197.8014	184.3053	176.5785	196.8436	199.0176	209.9529	219.0850	233.6465	(219)
Water heating fuel used												2491.5695	(219)
Annual totals kWh/year													
Space heating fuel - main system												4706.6008	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7689.2497	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4706.6008	0.2160	1016.6258	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2491.5695	0.2160	538.1790	(264)
Space and water heating			1554.8048	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1809.6750	(272)
Emissions per m2 for space and water heating			16.2450	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2450 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.9100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3718	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3718	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4740	0.4647	0.4554	0.4089	0.3996	0.3532	0.3532	0.3439	0.3718	0.3996	0.4182	0.4368	(22b)
Effective ac	0.6123	0.6080	0.6037	0.5836	0.5799	0.5624	0.5624	0.5591	0.5691	0.5799	0.5875	0.5954	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9941	49.6379	49.2889	47.6492	47.3424	45.9144	45.9144	45.6499	46.4644	47.3424	47.9630	48.6118	(38)
Heat transfer coeff	123.7787	123.4226	123.0735	121.4339	121.1271	119.6990	119.6990	119.4345	120.2491	121.1271	121.7477	122.3965	(39)
Average = Sum(39)m / 12 =												121.4324	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2933	1.2895	1.2859	1.2688	1.2656	1.2506	1.2506	1.2479	1.2564	1.2656	1.2720	1.2788	(40)
HLP (average)												1.2688	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487	(83)
Total gains	490.7074	576.7888	665.1225	763.6862	835.6455	830.0629	789.2535	719.1858	641.6805	549.4501	482.3428	461.9342	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2409	36.3455	36.4486	36.9407	37.0343	37.4761	37.4761	37.5591	37.3047	37.0343	36.8455	36.6502	
alpha	3.4161	3.4230	3.4299	3.4627	3.4690	3.4984	3.4984	3.5039	3.4870	3.4690	3.4564	3.4433	
util living area													
	0.9944	0.9897	0.9785	0.9473	0.8756	0.7455	0.6030	0.6640	0.8648	0.9675	0.9906	0.9955	(86)
MIT	18.9852	19.1915	19.5510	20.0428	20.4930	20.8102	20.9345	20.9073	20.6464	20.0649	19.4427	18.9562	(87)
Th 2	19.8461	19.8490	19.8519	19.8654	19.8679	19.8797	19.8797	19.8819	19.8752	19.8679	19.8628	19.8575	(88)
util rest of house													
	0.9930	0.9871	0.9727	0.9321	0.8367	0.6623	0.4747	0.5391	0.8068	0.9553	0.9878	0.9943	(89)
MIT 2	18.0127	18.2200	18.5786	19.0701	19.4953	19.7737	19.8566	19.8456	19.6477	19.1003	18.4813	17.9920	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1607	18.3678	18.7265	19.2181	19.6471	19.9314	20.0206	20.0071	19.7996	19.2471	18.6276	18.1387	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1607	18.3678	18.7265	19.2181	19.6471	19.9314	20.0206	20.0071	19.7996	19.2471	18.6276	18.1387	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9824	0.9651	0.9210	0.8277	0.6667	0.4923	0.5547	0.8020	0.9463	0.9835	0.9919	(94)
Useful gains	485.8181	566.6381	641.9363	703.3670	691.6234	553.3673	388.5141	398.9678	514.6260	519.9331	474.3813	458.1761	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1715.6545	1662.2279	1504.7604	1252.9634	962.6066	638.1644	409.4408	430.8173	685.3692	1047.3933	1403.4536	1706.0505	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	914.9983	736.2363	641.9411	395.7094	201.6115	0.0000	0.0000	0.0000	0.0000	392.4304	668.9321	928.4186	(98)
Space heating												4880.2777	(98)
Space heating per m2											(98) / (4) =	50.9903	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1125.1706	885.7726	907.7025	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7590	0.8302	0.7928	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	854.0345	735.3862	719.6378	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1073.3752	1023.5254	943.6094	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	157.9253	214.3756	166.6349	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												538.9358	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.4813	53.5939	41.6587	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												134.7340	(107)
Space cooling per m2												1.4077	(108)
Energy for space heating												50.9903	(99)
Energy for space cooling												1.4077	(108)
Total												52.3980	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3713	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	93.8213	169.3875	257.1968	361.3096	443.6078	457.5155	433.9710	369.9562	292.8388	194.0668	114.1200	79.1631	(83)
Total gains	475.7915	549.8592	624.2328	706.2444	765.1198	757.3261	720.2599	660.3693	595.1244	518.5969	464.1998	449.3487	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9991	0.9980	0.9947	0.9814	0.9347	0.8129	0.6535	0.7200	0.9228	0.9901	0.9982	0.9993	(86)
MIT	19.5603	19.7042	19.9598	20.3185	20.6561	20.8919	20.9720	20.9556	20.7684	20.3371	19.8902	19.5421	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9988	0.9973	0.9926	0.9732	0.9037	0.7262	0.5142	0.5845	0.8724	0.9845	0.9975	0.9991	(89)
MIT 2	18.5829	18.7289	18.9859	19.3510	19.6731	19.8775	19.9236	19.9196	19.7851	19.3743	18.9259	18.5737	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.7316	18.8773	19.1341	19.4982	19.8226	20.0318	20.0831	20.0772	19.9347	19.5208	19.0726	18.7210	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7316	18.8773	19.1341	19.4982	19.8226	20.0318	20.0831	20.0772	19.9347	19.5208	19.0726	18.7210	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9964	0.9906	0.9691	0.9002	0.7356	0.5355	0.6047	0.8729	0.9816	0.9966	0.9987	(94)
Useful gains	474.9945	547.8782	618.3693	684.3915	688.7674	557.0906	385.6696	399.3416	519.4836	509.0565	462.6257	448.7831	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1696.8392	1638.4601	1476.6080	1221.3360	933.5651	616.5623	395.3676	416.4294	665.4908	1025.3023	1383.4636	1687.3436	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	909.0525	732.8710	638.5296	386.6001	182.1295	0.0000	0.0000	0.0000	0.0000	384.0869	663.0033	921.4890	(98)
Space heating												4817.7619	(98)
Space heating per m2											(98) / (4) =	50.3371	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7973	0.8748	0.8376	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	850.7337	734.7928	720.8928	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	988.3582	942.8835	874.8630	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	99.0897	154.8195	114.5538	0.0000	0.0000	0.0000	0.0000	(104)

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Space cooling												368.4630 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	24.7724	38.7049	28.6384	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												92.1157 (107)
Space cooling per m2												0.9624 (108)
Energy for space heating												50.3371 (99)
Energy for space cooling												0.9624 (108)
Total												51.2995 (109)
Target Fabric Energy Efficiency (TFEE)												59.0 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4122	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	12.9236	0.4600	0.0000	0.7700	19.7291	(75)
Southeast	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(77)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northwest	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(81)
Northeast	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(75)

Solar gains	121.1212	197.4225	297.7331	433.2803	519.5294	573.7061	538.2061	468.4919	368.2936	241.9775	151.0643	101.1307	(83)
Total gains	739.1227	810.4247	886.5191	984.6035	1032.4130	1052.4050	997.1455	936.5487	858.1194	769.4905	720.3472	702.0945	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6931	36.9077	36.9077	37.2143	37.2143	37.5928	37.5015	37.6817	37.5928	37.4080	37.4080	37.1142	
alpha	3.4462	3.4605	3.4605	3.4810	3.4810	3.5062	3.5001	3.5121	3.5062	3.4939	3.4939	3.4743	
util living area													
	0.9776	0.9679	0.9428	0.8784	0.7496	0.5305	0.3645	0.3963	0.6882	0.8981	0.9626	0.9806	(86)
MIT	19.4359	19.6050	19.9516	20.3915	20.7551	20.9506	20.9905	20.9874	20.8690	20.4381	19.8851	19.4151	(87)
Th 2	19.8586	19.8645	19.8645	19.8727	19.8727	19.8828	19.8804	19.8851	19.8828	19.8779	19.8779	19.8701	(88)
util rest of house													
	0.9722	0.9603	0.9285	0.8472	0.6849	0.4260	0.2364	0.2632	0.5922	0.8645	0.9521	0.9759	(89)
MIT 2	17.8221	18.0691	18.5645	19.1796	19.6442	19.8545	19.8781	19.8818	19.7871	19.2601	18.4845	17.7996	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.0676	18.3028	18.7755	19.3640	19.8132	20.0212	20.0474	20.0500	19.9517	19.4393	18.6976	18.0453	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9176	18.1528	18.6255	19.2140	19.6632	19.8712	19.8974	19.9000	19.8017	19.2893	18.5476	17.8953	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9589	0.9442	0.9077	0.8248	0.6712	0.4249	0.2384	0.2650	0.5843	0.8419	0.9346	0.9638	(94)
Useful gains	708.7427	765.1810	804.7290	812.1240	692.9982	447.1328	237.6944	248.2225	501.3950	647.8638	673.2140	676.6887	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1567.0004	1525.6970	1364.3771	1122.7169	803.1903	461.9431	238.9194	249.9995	549.1066	922.0844	1264.8383	1546.5269	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	638.5438	511.0667	416.3781	223.6269	81.9829	0.0000	0.0000	0.0000	0.0000	204.0201	425.9695	647.1596	(98)
Space heating												3148.7476	(98)
RHI space heating demand												3149	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.4122	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004	(36)
Total fabric heat loss	(33) + (36) =	73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487	(83)
Total gains	726.7387	809.3193	886.8726	970.0746	1027.0171	1008.9512	961.9041	896.8294	829.2207	752.4329	701.5460	692.7124	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9817	0.9724	0.9528	0.9057	0.8134	0.6645	0.5189	0.5682	0.7802	0.9261	0.9718	0.9843	(86)
MIT	19.2373	19.4337	19.7691	20.2206	20.6098	20.8675	20.9581	20.9422	20.7540	20.2599	19.6804	19.2100	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9774	0.9660	0.9413	0.8817	0.7643	0.5773	0.3997	0.4486	0.7065	0.9022	0.9641	0.9806	(89)
MIT 2	17.5155	17.8014	18.2853	18.9316	19.4525	19.7675	19.8497	19.8421	19.6488	19.0009	18.1720	17.4846	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.7774	18.0497	18.5111	19.1277	19.6285	19.9349	20.0183	20.0095	19.8170	19.1924	18.4015	17.7470	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6274	17.8997	18.3611	18.9777	19.4785	19.7849	19.8683	19.8595	19.6670	19.0424	18.2515	17.5970	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9655	0.9507	0.9215	0.8585	0.7453	0.5701	0.3995	0.4471	0.6914	0.8796	0.9486	0.9699	(94)
Useful gains	701.6404	769.3900	817.2501	832.8100	765.3970	575.1688	384.2591	400.9691	573.3235	661.8448	665.4531	671.8658	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1677.6751	1630.7284	1482.8053	1239.5476	953.8201	626.6765	395.0326	417.0069	676.6228	1035.2271	1375.9247	1663.6754	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	726.1698	578.8194	495.1731	292.8510	140.1868	0.0000	0.0000	0.0000	0.0000	277.7964	511.5396	737.9064	(98)
Space heating												3760.4425	(98)
Space heating per m2											(98) / (4) =	39.2900	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4155.1850	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.1698	578.8194	495.1731	292.8510	140.1868	0.0000	0.0000	0.0000	0.0000	277.7964	511.5396	737.9064	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	802.3975	639.5795	547.1526	323.5923	154.9025	0.0000	0.0000	0.0000	0.0000	306.9574	565.2371	815.3661	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8622	89.8120	89.7019	89.4412	88.9013	87.3000	87.3000	87.3000	87.3000	89.3765	89.7292	89.8851	(217)
Fuel for water heating, kWh/month													
	194.0580	170.2574	176.9483	156.1800	151.8610	135.0886	126.8064	143.1997	144.2255	162.2218	174.4831	188.3698	(219)
Water heating fuel used												1923.6996	(219)
Annual totals kWh/year													
Space heating fuel - main system												4155.1850	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												6569.9641	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4155.1850	3.4800	144.6004	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1923.6996	3.4800	66.9447	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Total energy cost			396.3186	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1830	(257)
SAP value		83.4978	
SAP rating (Section 12)		83	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4155.1850	0.2160	897.5200	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1923.6996	0.2160	415.5191	(264)
Space and water heating			1313.0391	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1567.9093	(272)
CO2 emissions per m2			16.3800	(273)
EI value			85.0686	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (64)

Total per year (kWh/year) = Sum(64)m = 1711.1415 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	12.9236	0.4600	0.0000	0.7700	19.7291	(75)
Southeast	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(77)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northwest	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(81)
Northeast	3.3300	12.9236	0.4600	0.0000	0.7700	15.2432	(75)

Solar gains	121.1212	197.4225	297.7331	433.2803	519.5294	573.7061	538.2061	468.4919	368.2936	241.9775	151.0643	101.1307	(83)
Total gains	739.1227	810.4247	886.5191	984.6035	1032.4130	1052.4050	997.1455	936.5487	858.1194	769.4905	720.3472	702.0945	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6931	36.9077	36.9077	37.2143	37.2143	37.5928	37.5015	37.6817	37.5928	37.4080	37.4080	37.1142	
alpha	3.4462	3.4605	3.4605	3.4810	3.4810	3.5062	3.5001	3.5121	3.5062	3.4939	3.4939	3.4743	
util living area	0.9776	0.9679	0.9428	0.8784	0.7496	0.5305	0.3645	0.3963	0.6882	0.8981	0.9626	0.9806	(86)
MIT	19.4359	19.6050	19.9516	20.3915	20.7551	20.9506	20.9905	20.9874	20.8690	20.4381	19.8851	19.4151	(87)
Th 2	19.8586	19.8645	19.8645	19.8727	19.8727	19.8828	19.8804	19.8851	19.8828	19.8779	19.8779	19.8701	(88)
util rest of house	0.9722	0.9603	0.9285	0.8472	0.6849	0.4260	0.2364	0.2632	0.5922	0.8645	0.9521	0.9759	(89)
MIT 2	17.8221	18.0691	18.5645	19.1796	19.6442	19.8545	19.8781	19.8818	19.7871	19.2601	18.4845	17.7996	(90)

Living area fraction fLA = Living area / (4) = 0.1521 (91)

MIT	18.0676	18.3028	18.7755	19.3640	19.8132	20.0212	20.0474	20.0500	19.9517	19.4393	18.6976	18.0453	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9176	18.1528	18.6255	19.2140	19.6632	19.8712	19.8974	19.9000	19.8017	19.2893	18.5476	17.8953	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9589	0.9442	0.9077	0.8248	0.6712	0.4249	0.2384	0.2650	0.5843	0.8419	0.9346	0.9638	(94)
Useful gains	708.7427	765.1810	804.7290	812.1240	692.9982	447.1328	237.6944	248.2225	501.3950	647.8638	673.2140	676.6887	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1567.0004	1525.6970	1364.3771	1122.7169	803.1903	461.9431	238.9194	249.9995	549.1066	922.0844	1264.8383	1546.5269	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	638.5438	511.0667	416.3781	223.6269	81.9829	0.0000	0.0000	0.0000	0.0000	204.0201	425.9695	647.1596	(98)

Space heating 3148.7476 (98)

Space heating per m2 (98) / (4) = 32.8988 (99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3479.2791	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	638.5438	511.0667	416.3781	223.6269	81.9829	0.0000	0.0000	0.0000	0.0000	204.0201	425.9695	647.1596	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	705.5732	564.7146	460.0863	247.1016	90.5888	0.0000	0.0000	0.0000	0.0000	225.4366	470.6845	715.0935	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7939	89.7424	89.5936	89.2423	88.4821	87.3000	87.3000	87.3000	87.3000	89.1426	89.6171	89.8173	(217)
Fuel for water heating, kWh/month													
	194.2054	170.3895	177.1621	156.5282	152.5806	135.0886	126.8064	143.1997	144.2255	162.6475	174.7014	188.5120	(219)
Water heating fuel used												1926.0469	(219)
Annual totals kWh/year													
Space heating fuel - main system												3479.2791	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												5896.4053	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3479.2791	3.9200	136.3877	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1926.0469	3.9200	75.5010	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Total energy cost			383.1758	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3479.2791	0.2160	751.5243	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0469	0.2160	416.0261	(264)
Space and water heating			1167.5504	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1422.4206	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3479.2791	1.2200	4244.7205	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0469	1.2200	2349.7772	(264)
Space and water heating			6594.4977	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Primary energy kWh/year			8102.1113	(272)
Primary energy kWh/m2/year			84.6527	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 30	-188 kg (13.2%)
U Solar photovoltaic panels	+ 9.5	-£ 309	-947 kg (76.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.97 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.89 kg/m²	A 94	A 95
Total Savings	£340	11.86 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£83	£92	-£8
Mains gas	£300	£261	£39
Space heating	£237	£237	£0
Water heating	£76	£45	£30
Lighting	£71	£71	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£383	£44	£340
Total cost of uses	£384	£44	£339
Delivered energy	62 kWh/m²	33 kWh/m²	29 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	85 kWh/m²	15 kWh/m²	70 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.1734 (H8)
Utilisation factor	0.5735 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	98.2325 (H14)
Volume ratio Veff/V	0.7635 (H15)
Solar storage volume factor	0.9460 (H16)
Solar input	-865.2421 (H17)

Solar input

	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963 (63)

Solar input (sum of months) = Sum(63)m = -865.2421 (63)

Output from w/h

	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200 (64)

Total per year (kWh/year) = Sum(64)m = 849.7380 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.4600	0.0000	0.7700	17.2246	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	108.7372	196.3171	298.0865	418.7514	514.1335	530.2523	502.9646	428.7726	339.3949	224.9200	132.2630	91.7487 (83)
Total gains	726.7387	809.3193	886.8726	970.0746	1027.0171	1008.9512	961.9041	896.8294	829.2207	752.4329	701.5460	692.7124 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9817	0.9724	0.9528	0.9057	0.8134	0.6645	0.5189	0.5682	0.7802	0.9261	0.9718	0.9843	(86)
MIT	19.2373	19.4337	19.7691	20.2206	20.6098	20.8675	20.9581	20.9422	20.7540	20.2599	19.6804	19.2100	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9774	0.9660	0.9413	0.8817	0.7643	0.5773	0.3997	0.4486	0.7065	0.9022	0.9641	0.9806	(89)
MIT 2	17.5155	17.8014	18.2853	18.9316	19.4525	19.7675	19.8497	19.8421	19.6488	19.0009	18.1720	17.4846	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.7774	18.0497	18.5111	19.1277	19.6285	19.9349	20.0183	20.0095	19.8170	19.1924	18.4015	17.7470	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6274	17.8997	18.3611	18.9777	19.4785	19.7849	19.8683	19.8595	19.6670	19.0424	18.2515	17.5970	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9655	0.9507	0.9215	0.8585	0.7453	0.5701	0.3995	0.4471	0.6914	0.8796	0.9486	0.9699	(94)
Useful gains	701.6404	769.3900	817.2501	832.8100	765.3970	575.1688	384.2591	400.9691	573.3235	661.8448	665.4531	671.8658	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1677.6751	1630.7284	1482.8053	1239.5476	953.8201	626.6765	395.0326	417.0069	676.6228	1035.2271	1375.9247	1663.6754	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	726.1698	578.8194	495.1731	292.8510	140.1868	0.0000	0.0000	0.0000	0.0000	277.7964	511.5396	737.9064	(98)
Space heating												3760.4425	(98)
Space heating per m2											(98) / (4) =	39.2900	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4155.1850	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.1698	578.8194	495.1731	292.8510	140.1868	0.0000	0.0000	0.0000	0.0000	277.7964	511.5396	737.9064	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	802.3975	639.5795	547.1526	323.5923	154.9025	0.0000	0.0000	0.0000	0.0000	306.9574	565.2371	815.3661	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9378	89.9692	90.0050	90.0677	90.1437	87.3000	87.3000	87.3000	87.3000	89.6857	89.8458	89.9482	(217)
Fuel for water heating, kWh/month													
	165.9974	123.4236	97.1270	48.9899	18.7963	2.1281	0.0000	28.5666	54.4449	101.9838	141.1326	164.8950	(219)
Water heating fuel used												947.4852	(219)
Annual totals kWh/year													
Space heating fuel - main system												4155.1850	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3916.5102	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4155.1850	3.4800	144.6004	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.4852	3.4800	32.9725	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			141.1184	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4212	(257)
SAP value	94.1240	
SAP rating (Section 12)	94	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4155.1850	0.2160	897.5200	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.4852	0.2160	204.6568	(264)
Space and water heating			1102.1768	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			486.5597	(272)
CO2 emissions per m2			5.0800	(273)
EI value			95.3664	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
             174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.2393 (H8)
Utilisation factor                                                                                                                  0.5538 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             98.2325 (H14)
Volume ratio Veff/V                                                                                                                 0.7635 (H15)
Solar storage volume factor                                                                                                         0.9460 (H16)
Solar input                                                                                                                      -882.3194 (H17)
Solar input    -27.1574   -40.8174   -68.7417   -95.0221  -114.4386  -120.4417  -117.5496  -104.9725   -81.9314   -55.7364   -33.0105   -22.5000 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =  -882.3194 (63)
Output from w/h
             147.2273   112.0942    89.9842    44.6672    20.5678     0.0000     0.0000    20.0408    43.9775    89.2518   123.5519   146.8163 (64)
                                                                                                Total per year (kWh/year) = Sum(64)m =    838.1790 (64)
Heat gains from water heating, kWh/month
              56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)


-------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
              76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
             618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area        Solar flux          g              FF          Access          Gains
                                          m2          Table 6a    Specific data  Specific data    factor           W
                                                         W/m2    or Table 6b    or Table 6c    Table 6d
-------------------------------------------------------------------------------------------------------------
Northeast                               4.3100          12.9236         0.4600         0.0000         0.7700      19.7291 (75)
Southeast                               0.7200          40.4699         0.4600         0.0000         0.7700      10.3208 (77)
Southwest                               5.0600          40.4699         0.4600         0.0000         0.7700      72.5323 (79)
Northwest                               0.7200          12.9236         0.4600         0.0000         0.7700       3.2958 (81)
Northeast                               3.3300          12.9236         0.4600         0.0000         0.7700      15.2432 (75)
-------------------------------------------------------------------------------------------------------------

Solar gains    121.1212   197.4225   297.7331   433.2803   519.5294   573.7061   538.2061   468.4919   368.2936   241.9775   151.0643   101.1307 (83)
Total gains    739.1227   810.4247   886.5191   984.6035  1032.4130  1052.4050   997.1455   936.5487   858.1194   769.4905   720.3472   702.0945 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          36.6931    36.9077    36.9077    37.2143    37.2143    37.5928    37.5015    37.6817    37.5928    37.4080    37.4080    37.1142
alpha         3.4462     3.4605     3.4605     3.4810     3.4810     3.5062     3.5001     3.5121     3.5062     3.4939     3.4939     3.4743
util living area
               0.9776     0.9679     0.9428     0.8784     0.7496     0.5305     0.3645     0.3963     0.6882     0.8981     0.9626     0.9806 (86)

MIT           19.4359    19.6050    19.9516    20.3915    20.7551    20.9506    20.9905    20.9874    20.8690    20.4381    19.8851    19.4151 (87)
Th 2          19.8586    19.8645    19.8645    19.8727    19.8727    19.8828    19.8804    19.8851    19.8828    19.8779    19.8779    19.8701 (88)
util rest of house
               0.9722     0.9603     0.9285     0.8472     0.6849     0.4260     0.2364     0.2632     0.5922     0.8645     0.9521     0.9759 (89)
MIT 2         17.8221    18.0691    18.5645    19.1796    19.6442    19.8545    19.8781    19.8818    19.7871    19.2601    18.4845    17.7996 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1521 (91)
MIT           18.0676    18.3028    18.7755    19.3640    19.8132    20.0212    20.0474    20.0500    19.9517    19.4393    18.6976    18.0453 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  17.9176    18.1528    18.6255    19.2140    19.6632    19.8712    19.8974    19.9000    19.8017    19.2893    18.5476    17.8953 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9589	0.9442	0.9077	0.8248	0.6712	0.4249	0.2384	0.2650	0.5843	0.8419	0.9346	0.9638	(94)
Useful gains	708.7427	765.1810	804.7290	812.1240	692.9982	447.1328	237.6944	248.2225	501.3950	647.8638	673.2140	676.6887	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1567.0004	1525.6970	1364.3771	1122.7169	803.1903	461.9431	238.9194	249.9995	549.1066	922.0844	1264.8383	1546.5269	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	638.5438	511.0667	416.3781	223.6269	81.9829	0.0000	0.0000	0.0000	0.0000	204.0201	425.9695	647.1596	(98)

Space heating 3148.7476 (98)
Space heating per m2 (98) / (4) = 32.8988 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3479.2791 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	638.5438	511.0667	416.3781	223.6269	81.9829	0.0000	0.0000	0.0000	0.0000	204.0201	425.9695	647.1596	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	705.5732	564.7146	460.0863	247.1016	90.5888	0.0000	0.0000	0.0000	0.0000	225.4366	470.6845	715.0935	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	147.2273	112.0942	89.9842	44.6672	20.5678	0.0000	0.0000	20.0408	43.9775	89.2518	123.5519	146.8163	(64)

Efficiency of water heater 87.3000 (216)

(217)m	89.8827	89.9072	89.9143	89.9511	89.8395	87.3000	87.3000	87.3000	87.3000	89.5016	89.7603	89.8907	(217)

Fuel for water heating, kWh/month

	163.7994	124.6777	100.0777	49.6572	22.8940	0.0000	0.0000	22.9562	50.3751	99.7209	137.6466	163.3275	(219)

Water heating fuel used 935.1324 (219)
Annual totals kWh/year
Space heating fuel - main system 3479.2791 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596 -1824.1596 (233)
Total delivered energy for all uses 3131.3312 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3479.2791	3.9200	136.3877	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	935.1324	3.9200	36.6572	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			43.4345	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3479.2791	0.2160	751.5243	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.1324	0.2160	201.9886	(264)
Space and water heating			953.5129	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			287.5942	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3479.2791	1.2200	4244.7205	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.1324	1.2200	1140.8615	(264)
Space and water heating			5385.5820	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1446.5255	(272)
Primary energy kWh/m2/year			15.1136	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.78 (37)
Summer heat loss coefficient		400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.3100	98.8453	0.4600	0.0000	0.9000	176.3736
South East	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
South West	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North West	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
North East	3.3300	98.8453	0.4600	0.0000	0.9000	136.2701
total:						629.0720

	Jun	Jul	Aug	
Solar gains	671	629	548	(P4)
Internal gains	476	456	465	
Total summer gains	1146	1085	1013	(P5)
Summer gain/loss ratio	2.86	2.71	2.53	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.68	21.43	21.15	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-336	**Issued on Date**	19/10/2022
Assessment Reference	Plot 336	**Prop Type Ref**	Badlesmere-As-SEMI
Property	Plot 336, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.42	**TER**	18.80
Environmental	86 B	**% DER<TER**	7.32		
CO_2 Emissions (t/year)	1.15	**DFEE**	46.69	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.57		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.42 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.7 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.51 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	479.6579	561.5879	644.2821	735.1563	801.3877	794.4072	755.2121	692.5931	621.1219	535.3775	472.1484	452.0581	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9872	0.9779	0.9577	0.9076	0.8095	0.6589	0.5169	0.5726	0.7918	0.9376	0.9794	0.9894	(86)
MIT	19.0188	19.2528	19.6386	20.1487	20.5793	20.8555	20.9524	20.9327	20.7152	20.1522	19.5033	18.9887	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9845	0.9732	0.9482	0.8860	0.7638	0.5778	0.4053	0.4604	0.7254	0.9185	0.9741	0.9871	(89)
MIT 2	17.2511	17.5925	18.1511	18.8835	19.4647	19.8084	19.9009	19.8898	19.6572	18.9046	17.9696	17.2157	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6163	17.9355	18.4583	19.1449	19.6950	20.0247	20.1181	20.1052	19.8758	19.1623	18.2865	17.5820	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4663	17.7855	18.3083	18.9949	19.5450	19.8747	19.9681	19.9552	19.7258	19.0123	18.1365	17.4320	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9599	0.9294	0.8630	0.7458	0.5735	0.4099	0.4634	0.7112	0.8971	0.9613	0.9791	(94)
Useful gains	467.7474	539.0535	598.7980	634.4745	597.6653	455.6284	309.5655	320.9251	441.7294	480.2665	453.8822	442.6007	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1306.8780	1274.3286	1163.6010	977.8810	757.4813	501.6242	320.3083	337.1474	538.1691	812.2641	1072.6228	1294.7530	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	624.3132	494.1048	420.2134	247.2526	118.9031	0.0000	0.0000	0.0000	0.0000	247.0062	445.4932	634.0013	(98)
Space heating												3231.2878	(98)
Space heating per m2											(98) / (4) =	40.5025	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3570.4838	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	624.3132	494.1048	420.2134	247.2526	118.9031	0.0000	0.0000	0.0000	0.0000	247.0062	445.4932	634.0013	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	689.8488	545.9722	464.3242	273.2073	131.3846	0.0000	0.0000	0.0000	0.0000	272.9350	492.2577	700.5539	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8113	89.7542	89.6341	89.3576	88.8121	87.3000	87.3000	87.3000	87.3000	89.3294	89.6789	89.8352	(217)
Fuel for water heating, kWh/month													
	183.9011	161.3754	167.7776	148.1899	144.1601	128.1956	120.4190	135.8687	136.8056	153.8557	165.4048	178.5342	(219)
Water heating fuel used												1824.4876	(219)
Annual totals kWh/year													
Space heating fuel - main system												3570.4838	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5826.8841	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3570.4838	0.2160	771.2245	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.4876	0.2160	394.0893	(264)
Space and water heating			1165.3138	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1389.4765	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.4200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.4200	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.9163	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.9163	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	477.5869	547.6749	616.5471	691.3466	744.8356	735.2710	699.5666	646.9839	587.4835	517.1391	466.6654	452.2359	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9980	0.9957	0.9889	0.9637	0.8870	0.7269	0.5592	0.6206	0.8638	0.9786	0.9960	0.9985	(86)
MIT	19.7087	19.8601	20.1164	20.4641	20.7652	20.9407	20.9872	20.9790	20.8516	20.4640	20.0278	19.6869	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9973	0.9943	0.9849	0.9494	0.8433	0.6351	0.4355	0.4946	0.7952	0.9677	0.9943	0.9980	(89)
MIT 2	18.2122	18.4352	18.8096	19.3156	19.7192	19.9241	19.9593	19.9574	19.8374	19.3243	18.6903	18.1882	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9918	0.9803	0.9426	0.8424	0.6514	0.4611	0.5206	0.8020	0.9621	0.9920	0.9969	(94)
Useful gains	475.6656	543.1912	604.4008	651.6306	627.4780	478.9734	322.5858	336.8015	471.1769	497.5321	462.9126	450.8347	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1346.2718	1305.2056	1183.6873	988.2939	761.9733	505.6645	326.3480	343.5284	546.0281	829.0043	1103.9086	1337.5610	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating												3301.1128	(98)
Space heating per m2											(98) / (4) =	41.3777	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3534.3820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	693.5022	548.2588	461.4445	259.5263	107.1355	0.0000	0.0000	0.0000	0.0000	264.0421	494.1297	706.3430	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7754	87.5675	87.1161	86.0393	83.9305	80.3000	80.3000	80.3000	80.3000	85.9645	87.2817	87.8566	(217)
Fuel for water heating, kWh/month													
	230.1369	202.4498	211.7275	190.1418	188.7161	173.7253	166.4421	185.5439	187.5930	199.5363	209.7868	224.4996	(219)
Water heating fuel used												2370.2991	(219)
Annual totals kWh/year													
Space heating fuel - main system												3534.3820	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6336.5938	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3534.3820	0.2160	763.4265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.2991	0.2160	511.9846	(264)
Space and water heating			1275.4111	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1499.5738	(272)
Emissions per m2 for space and water heating			15.9866	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9866 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	447.5515	530.2595	614.5686	707.6361	775.2921	770.3155	732.8207	668.0200	595.7713	507.7574	441.9653	420.7243	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9895	0.9811	0.9621	0.9141	0.8178	0.6685	0.5256	0.5846	0.8040	0.9446	0.9828	0.9915	(86)
MIT	19.0090	19.2437	19.6308	20.1395	20.5741	20.8523	20.9513	20.9301	20.7061	20.1348	19.4838	18.9735	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9873	0.9769	0.9535	0.8937	0.7734	0.5882	0.4138	0.4723	0.7396	0.9274	0.9784	0.9896	(89)
MIT 2	18.0909	18.3257	18.7096	19.2122	19.6147	19.8541	19.9192	19.9111	19.7451	19.2189	18.5758	18.0637	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2805	18.5153	18.8998	19.4038	19.8129	20.0603	20.1324	20.1216	19.9436	19.4081	18.7634	18.2517	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2805	18.5153	18.8998	19.4038	19.8129	20.0603	20.1324	20.1216	19.9436	19.4081	18.7634	18.2517	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9825	0.9699	0.9433	0.8818	0.7681	0.5983	0.4355	0.4930	0.7404	0.9167	0.9718	0.9856	(94)
Useful gains	439.7408	514.2881	579.7164	624.0133	595.5179	460.8718	319.1219	329.3351	441.1086	465.4776	429.5150	414.6466	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1360.7360	1321.2651	1199.8110	1002.4138	772.2257	513.4322	332.1503	349.1455	552.0724	838.3971	1116.0390	1351.9426	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	685.2204	542.2885	461.3504	272.4484	131.4706	0.0000	0.0000	0.0000	0.0000	277.4521	494.2973	697.3482	(98)
Space heating												3561.8758	(98)
Space heating per m2											(98) / (4) =	44.6462	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8136	0.8730	0.8423	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	719.1125	607.4625	600.5834	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	992.3023	946.6035	872.4862	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	196.6966	252.3209	202.2957	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												651.3132	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	49.1742	63.0802	50.5739	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												162.8283	(107)
Space cooling per m2												2.0410	(108)
Energy for space heating												44.6462	(99)
Energy for space cooling												2.0410	(108)
Total												46.6872	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	433.1016	504.2784	575.3879	653.0008	708.5389	701.6006	667.5895	612.2030	551.2975	478.0634	424.4085	408.5193	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9987	0.9970	0.9917	0.9707	0.9027	0.7505	0.5827	0.6495	0.8862	0.9844	0.9974	0.9991	(86)
MIT	19.6571	19.8103	20.0706	20.4261	20.7404	20.9314	20.9847	20.9744	20.8293	20.4223	19.9791	19.6360	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9983	0.9960	0.9886	0.9588	0.8626	0.6596	0.4554	0.5206	0.8236	0.9762	0.9962	0.9987	(89)
MIT 2	18.7060	18.8611	19.1221	19.4812	19.7733	19.9318	19.9601	19.9587	19.8607	19.4839	19.0407	18.6938	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9948	0.9862	0.9549	0.8636	0.6763	0.4820	0.5474	0.8309	0.9732	0.9952	0.9983	(94)
Useful gains	432.0941	501.6546	567.4314	623.5564	611.8767	474.5116	321.7777	335.1368	458.0803	465.2667	422.3545	407.8088	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1382.3519	1336.1274	1206.1322	999.7594	765.4717	506.0479	326.3571	343.5322	547.3010	839.9201	1128.8358	1374.1031	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	706.9918	560.7658	475.1934	270.8661	114.2746	0.0000	0.0000	0.0000	0.0000	278.7422	508.6665	718.9230	(98)
Space heating												3634.4234	(98)
Space heating per m2											(98) / (4) =	45.5556	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8585	0.9202	0.8915	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	737.3479	622.1787	617.6341	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	911.9861	870.3592	807.2455	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	125.7395	184.6463	141.0709	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												451.4567	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	31.4349	46.1616	35.2677	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												112.8642 (107)
Space cooling per m2												1.4147 (108)
Energy for space heating												45.5556 (99)
Energy for space cooling												1.4147 (108)
Total												46.9703 (109)
Target Fabric Energy Efficiency (TFEE)												54.0 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(75)
Southeast	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(77)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northeast	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(75)

Solar gains	117.2303	190.2581	284.9360	411.6500	491.3072	541.5794	508.4467	444.1451	351.3902	232.6113	146.0402	97.9896	(83)
Total gains	671.2227	739.8480	813.1455	906.7466	952.5301	972.4675	921.6193	865.5990	791.9135	706.4590	656.9047	636.8316	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9624	0.9471	0.9098	0.8239	0.6761	0.4602	0.3119	0.3397	0.6120	0.8494	0.9391	0.9671	(86)
MIT	19.5057	19.6922	20.0499	20.4813	20.8054	20.9632	20.9929	20.9907	20.8986	20.5129	19.9641	19.4800	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9547	0.9365	0.8912	0.7881	0.6128	0.3709	0.2071	0.2303	0.5233	0.8101	0.9247	0.9603	(89)
MIT 2	17.9719	18.2418	18.7478	19.3412	19.7467	19.9171	19.9349	19.9388	19.8638	19.4019	18.6439	17.9429	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2887	18.5415	19.0168	19.5767	19.9654	20.1332	20.1534	20.1561	20.0776	19.6314	18.9167	18.2604	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1387	18.3915	18.8668	19.4267	19.8154	19.9832	20.0034	20.0061	19.9276	19.4814	18.7667	18.1104	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9374	0.9165	0.8686	0.7687	0.6055	0.3748	0.2137	0.2371	0.5223	0.7900	0.9040	0.9442	(94)
Useful gains	629.1823	678.0764	706.2575	697.0146	576.7757	364.4539	196.9884	205.2336	413.6048	558.0943	593.8608	601.2979	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.9887	1223.6468	1096.9275	903.4299	646.3136	373.7174	197.8608	206.4717	443.5640	743.3238	1015.4383	1237.3004	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating												2237.7694	(98)
RHI space heating demand												2238	(98)

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9692	0.9541	0.9245	0.8591	0.7467	0.5885	0.4500	0.4956	0.7096	0.8871	0.9534	0.9732	(86)
MIT	19.2957	19.5140	19.8656	20.3178	20.6789	20.8977	20.9685	20.9564	20.8012	20.3386	19.7504	19.2639	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9630	0.9451	0.9092	0.8303	0.6953	0.5088	0.3486	0.3922	0.6360	0.8574	0.9426	0.9678	(89)
MIT 2	17.6498	17.9652	18.4680	19.1069	19.5808	19.8458	19.9102	19.9048	19.7460	19.1523	18.3206	17.6130	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9898	18.2851	18.7567	19.3570	19.8077	20.0631	20.1288	20.1220	19.9640	19.3974	18.6159	17.9540	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8398	18.1351	18.6067	19.2070	19.6577	19.9131	19.9788	19.9720	19.8140	19.2474	18.4659	17.8040	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9257	0.8865	0.8082	0.6819	0.5078	0.3538	0.3966	0.6278	0.8349	0.9232	0.9531	(94)
Useful gains	624.3229	684.0630	721.4315	722.0134	646.2987	473.1388	314.4043	328.5174	480.0955	576.3699	589.7925	598.3835	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1343.9566	1308.9042	1193.0034	998.4322	768.3643	505.2807	321.3262	338.7391	546.6053	834.9575	1104.6456	1331.1575	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating												2704.2559	(98)
Space heating per m2											(98) / (4) =	33.8964	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2988.1281	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	591.6104	463.9705	387.6790	219.9133	100.3500	0.0000	0.0000	0.0000	0.0000	212.5848	409.6069	602.4132	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7246	89.6571	89.5155	89.1938	88.6000	87.3000	87.3000	87.3000	87.3000	89.1385	89.5618	89.7522	(217)
Fuel for water heating, kWh/month	184.0787	161.5502	167.9997	148.4621	144.5051	128.1956	120.4190	135.8687	136.8056	154.1853	165.6211	178.6993	(219)
Water heating fuel used												1826.3904	(219)
Annual totals kWh/year													
Space heating fuel - main system												2988.1281	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5246.4311	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2988.1281	3.4800	103.9869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.3904	3.4800	63.5584	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			344.5145	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1596	(257)
SAP value		83.8234	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2988.1281	0.2160	645.4357	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.3904	0.2160	394.5003	(264)
Space and water heating			1039.9360	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1264.0986	(272)
CO2 emissions per m2			15.8400	(273)
EI value			86.4250	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(75)
Southeast	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(77)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northeast	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(75)

Solar gains	117.2303	190.2581	284.9360	411.6500	491.3072	541.5794	508.4467	444.1451	351.3902	232.6113	146.0402	97.9896	(83)
Total gains	671.2227	739.8480	813.1455	906.7466	952.5301	972.4675	921.6193	865.5990	791.9135	706.4590	656.9047	636.8316	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9624	0.9471	0.9098	0.8239	0.6761	0.4602	0.3119	0.3397	0.6120	0.8494	0.9391	0.9671	(86)
MIT	19.5057	19.6922	20.0499	20.4813	20.8054	20.9632	20.9929	20.9907	20.8986	20.5129	19.9641	19.4800	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9547	0.9365	0.8912	0.7881	0.6128	0.3709	0.2071	0.2303	0.5233	0.8101	0.9247	0.9603	(89)
MIT 2	17.9719	18.2418	18.7478	19.3412	19.7467	19.9171	19.9349	19.9388	19.8638	19.4019	18.6439	17.9429	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2887	18.5415	19.0168	19.5767	19.9654	20.1332	20.1534	20.1561	20.0776	19.6314	18.9167	18.2604	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1387	18.3915	18.8668	19.4267	19.8154	19.9832	20.0034	20.0061	19.9276	19.4814	18.7667	18.1104	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9374	0.9165	0.8686	0.7687	0.6055	0.3748	0.2137	0.2371	0.5223	0.7900	0.9040	0.9442	(94)
Useful gains	629.1823	678.0764	706.2575	697.0146	576.7757	364.4539	196.9884	205.2336	413.6048	558.0943	593.8608	601.2979	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.9887	1223.6468	1096.9275	903.4299	646.3136	373.7174	197.8608	206.4717	443.5640	743.3238	1015.4383	1237.3004	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating												2237.7694	(98)
Space heating per m2											(98) / (4) =	28.0493	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2472.6734	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	514.4750	405.1087	321.1696	164.2200	57.1671	0.0000	0.0000	0.0000	0.0000	152.2770	335.3987	522.8573	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6396	89.5702	89.3828	88.9635	88.1975	87.3000	87.3000	87.3000	87.3000	88.8734	89.4240	89.6680	(217)
Fuel for water heating, kWh/month													
	184.2532	161.7069	168.2491	148.8464	145.1647	128.1956	120.4190	135.8687	136.8056	154.6452	165.8763	178.8671	(219)
Water heating fuel used												1828.8978	(219)
Annual totals kWh/year													
Space heating fuel - main system												2472.6734	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4733.4838	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2472.6734	3.9200	96.9288	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.8978	3.9200	71.6928	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			329.8740	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2472.6734	0.2160	534.0974	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8978	0.2160	395.0419	(264)
Space and water heating			929.1394	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1153.3020	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2472.6734	1.2200	3016.6615	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8978	1.2200	2231.2553	(264)
Space and water heating			5247.9168	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6573.8886	(272)
Primary energy kWh/m2/year			82.4002	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.7%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£257	£219	£38
Space heating	£198	£198	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£330	-£8	£339
Total cost of uses	£331	-£7	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	82 kWh/m²	-1 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9692	0.9541	0.9245	0.8591	0.7467	0.5885	0.4500	0.4956	0.7096	0.8871	0.9534	0.9732	(86)
MIT	19.2957	19.5140	19.8656	20.3178	20.6789	20.8977	20.9685	20.9564	20.8012	20.3386	19.7504	19.2639	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9630	0.9451	0.9092	0.8303	0.6953	0.5088	0.3486	0.3922	0.6360	0.8574	0.9426	0.9678	(89)
MIT 2	17.6498	17.9652	18.4680	19.1069	19.5808	19.8458	19.9102	19.9048	19.7460	19.1523	18.3206	17.6130	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	17.9898	18.2851	18.7567	19.3570	19.8077	20.0631	20.1288	20.1220	19.9640	19.3974	18.6159	17.9540	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8398	18.1351	18.6067	19.2070	19.6577	19.9131	19.9788	19.9720	19.8140	19.2474	18.4659	17.8040	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9257	0.8865	0.8082	0.6819	0.5078	0.3538	0.3966	0.6278	0.8349	0.9232	0.9531	(94)
Useful gains	624.3229	684.0630	721.4315	722.0134	646.2987	473.1388	314.4043	328.5174	480.0955	576.3699	589.7925	598.3835	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1343.9566	1308.9042	1193.0034	998.4322	768.3643	505.2807	321.3262	338.7391	546.6053	834.9575	1104.6456	1331.1575	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating												2704.2559	(98)
Space heating per m2											(98) / (4) =	33.8964	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2988.1281	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	535.4075	419.8933	350.8495	199.0215	90.8168	0.0000	0.0000	0.0000	0.0000	192.3892	370.6942	545.1839	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	591.6104	463.9705	387.6790	219.9133	100.3500	0.0000	0.0000	0.0000	0.0000	212.5848	409.6069	602.4132	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8149	89.8461	89.8828	89.9566	90.0879	87.3000	87.3000	87.3000	87.3000	89.4926	89.6994	89.8275	(217)
Fuel for water heating, kWh/month													
	156.6635	115.7868	89.9833	43.6507	14.3747	0.0000	0.0000	24.1300	49.2919	95.2778	133.0265	155.7655	(219)
Water heating fuel used												877.9507	(219)
Annual totals kWh/year													
Space heating fuel - main system												2988.1281	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2620.7521	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2988.1281	3.4800	103.9869	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9507	3.4800	30.5527	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			90.2809	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3039	(257)
SAP value	95.7609	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2988.1281	0.2160	645.4357	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9507	0.2160	189.6374	(264)
Space and water heating			835.0730	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			188.7484	(272)
CO2 emissions per m2			2.3700	(273)
EI value			97.9730	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3147 (H8)
Utilisation factor                                                                                                                  0.5326 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -859.2180 (H17)
Solar input    -26.4463   -39.7487   -66.9419   -92.5342  -111.4423  -117.2882  -114.4719  -102.2241   -79.7862   -54.2771   -32.1462   -21.9109 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -859.2180 (63)
Output from w/h
             138.7176   105.0925    83.4439    39.8847    16.5893     0.0000     0.0000    16.3893    39.6451    83.1613   116.1870   138.4756 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =     777.5864 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


-------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2     or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
Northeast                              3.0000           12.9236           0.4600           0.0000           0.7700           13.7326 (75)
Southeast                              0.7200           40.4699           0.4600           0.0000           0.7700           10.3208 (77)
Southwest                              5.0600           40.4699           0.4600           0.0000           0.7700           72.5323 (79)
Northeast                              4.5100           12.9236           0.4600           0.0000           0.7700           20.6446 (75)
-------------------------------------------------------------------------------------------------------------

Solar gains    117.2303   190.2581   284.9360   411.6500   491.3072   541.5794   508.4467   444.1451   351.3902   232.6113   146.0402    97.9896 (83)
Total gains    671.2227   739.8480   813.1455   906.7466   952.5301   972.4675   921.6193   865.5990   791.9135   706.4590   656.9047   636.8316 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.7290    34.9430    34.9430    35.2490    35.2490    35.6271    35.5359    35.7161    35.6271    35.4424    35.4424    35.1491
alpha         3.3153     3.3295     3.3295     3.3499     3.3499     3.3751     3.3691     3.3811     3.3751     3.3628     3.3628     3.3433
util living area
               0.9624     0.9471     0.9098     0.8239     0.6761     0.4602     0.3119     0.3397     0.6120     0.8494     0.9391     0.9671 (86)

MIT           19.5057    19.6922    20.0499    20.4813    20.8054    20.9632    20.9929    20.9907    20.8986    20.5129    19.9641    19.4800 (87)
Th 2          19.9148    19.9207    19.9207    19.9291    19.9291    19.9392    19.9368    19.9416    19.9392    19.9343    19.9343    19.9264 (88)
util rest of house
               0.9547     0.9365     0.8912     0.7881     0.6128     0.3709     0.2071     0.2303     0.5233     0.8101     0.9247     0.9603 (89)
MIT 2         17.9719    18.2418    18.7478    19.3412    19.7467    19.9171    19.9349    19.9388    19.8638    19.4019    18.6439    17.9429 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.2887    18.5415    19.0168    19.5767    19.9654    20.1332    20.1534    20.1561    20.0776    19.6314    18.9167    18.2604 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1387    18.3915    18.8668    19.4267    19.8154    19.9832    20.0034    20.0061    19.9276    19.4814    18.7667    18.1104 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9374	0.9165	0.8686	0.7687	0.6055	0.3748	0.2137	0.2371	0.5223	0.7900	0.9040	0.9442	(94)
Useful gains	629.1823	678.0764	706.2575	697.0146	576.7757	364.4539	196.9884	205.2336	413.6048	558.0943	593.8608	601.2979	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.9887	1223.6468	1096.9275	903.4299	646.3136	373.7174	197.8608	206.4717	443.5640	743.3238	1015.4383	1237.3004	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating												2237.7694	(98)
Space heating per m2											(98) / (4) =	28.0493	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2472.6734	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	465.5999	366.6233	290.6585	148.6191	51.7362	0.0000	0.0000	0.0000	0.0000	137.8107	303.5358	473.1859	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	514.4750	405.1087	321.1696	164.2200	57.1671	0.0000	0.0000	0.0000	0.0000	152.2770	335.3987	522.8573	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7449	89.7669	89.7661	89.8035	89.7017	87.3000	87.3000	87.3000	87.3000	89.2685	89.5909	89.7552	(217)
Fuel for water heating, kWh/month	154.5688	117.0726	92.9571	44.4134	18.4939	0.0000	0.0000	18.7735	45.4125	93.1586	129.6862	154.2814	(219)
Water heating fuel used												868.8179	(219)

Annual totals kWh/year		
Space heating fuel - main system	2472.6734	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	1999.2443	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2472.6734	3.9200	96.9288	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.8179	3.9200	34.0577	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-8.6586	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2472.6734	0.2160	534.0974	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8179	0.2160	187.6647	(264)
Space and water heating			721.7621	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			25.1359	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2472.6734	1.2200	3016.6615	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8179	1.2200	1059.9579	(264)
Space and water heating			4076.6194	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-44.0789	(272)
Primary energy kWh/m2/year			-0.5525	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
South East	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
South West	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North East	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						594.2884

	Jun	Jul	Aug	
Solar gains	633	594	519	(P4)
Internal gains	428	410	418	
Total summer gains	1061	1004	938	(P5)
Summer gain/loss ratio	3.23	3.06	2.86	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.18	21.91	21.60	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-337	**Issued on Date**	19/10/2022
Assessment Reference	Plot 337	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	Plot 337, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.54	**TER**	18.99
Environmental	86 B	**% DER<TER**	7.65		
CO_2 Emissions (t/year)	1.16	**DFEE**	47.70	**TFEE**	55.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.95		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.99 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.54 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 7.51 m², No overhang
Windows facing South West: 5.06 m², No overhang
Windows facing North West: 2.16 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.038 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	100.9982	100.6351	100.2792	98.6077	98.2949	96.8391	96.8391	96.5695	97.3999	98.2949	98.9276	99.5890	(39)
Average = Sum(39)m / 12 =												98.6062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2660	1.2614	1.2569	1.2360	1.2321	1.2138	1.2138	1.2104	1.2209	1.2321	1.2400	1.2483	(40)
HLP (average)												1.2360	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	373.9690	371.8757	358.4017	336.6737	314.6131	293.3542	279.5453	285.5173	296.6803	318.6197	343.8235	362.7252	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	478.5582	562.8662	653.8190	759.8600	840.7808	838.6619	795.7314	721.3669	635.7911	538.8980	471.4349	450.7191	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8894	33.0081	33.1252	33.6868	33.7939	34.3020	34.3020	34.3977	34.1045	33.7939	33.5778	33.3548	
alpha	3.1926	3.2005	3.2083	3.2458	3.2529	3.2868	3.2868	3.2932	3.2736	3.2529	3.2385	3.2237	
util living area													
	0.9871	0.9776	0.9561	0.9016	0.7958	0.6408	0.5012	0.5610	0.7868	0.9369	0.9793	0.9893	(86)
MIT	18.9712	19.2102	19.6118	20.1444	20.5870	20.8605	20.9538	20.9330	20.7095	20.1280	19.4635	18.9402	(87)
Th 2	19.8676	19.8712	19.8747	19.8913	19.8944	19.9090	19.9090	19.9117	19.9034	19.8944	19.8881	19.8816	(88)
util rest of house													
	0.9843	0.9728	0.9463	0.8788	0.7482	0.5589	0.3903	0.4485	0.7191	0.9176	0.9739	0.9870	(89)
MIT 2	17.1727	17.5214	18.1025	18.8651	19.4589	19.7963	19.8846	19.8730	19.6359	18.8598	17.9025	17.1359	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.5442	17.8702	18.4143	19.1294	19.6920	20.0161	20.1054	20.0920	19.8577	19.1218	18.2250	17.5086	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3942	17.7202	18.2643	18.9794	19.5420	19.8661	19.9554	19.9420	19.7077	18.9718	18.0750	17.3586	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9591	0.9268	0.8552	0.7306	0.5554	0.3953	0.4519	0.7049	0.8957	0.9609	0.9787	(94)
Useful gains	466.4910	539.8496	605.9500	649.8169	614.3029	465.7656	314.5901	325.9866	448.1525	482.6765	453.0017	441.1373	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1322.4884	1290.1658	1179.7111	993.9056	770.8248	509.9688	324.9381	342.0454	546.1856	822.9010	1085.7302	1310.4540	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	636.8621	504.2124	426.8783	247.7439	116.4523	0.0000	0.0000	0.0000	0.0000	253.1271	455.5645	646.7716	(98)
Space heating												3287.6123	(98)
Space heating per m2											(98) / (4) =	41.2085	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3632.7207	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	636.8621	504.2124	426.8783	247.7439	116.4523	0.0000	0.0000	0.0000	0.0000	253.1271	455.5645	646.7716	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	703.7150	557.1408	471.6887	273.7501	128.6766	0.0000	0.0000	0.0000	0.0000	279.6984	503.3862	714.6648	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8220	89.7657	89.6440	89.3591	88.7955	87.3000	87.3000	87.3000	87.3000	89.3475	89.6925	89.8456	(217)
Fuel for water heating, kWh/month													
	183.8792	161.3547	167.7590	148.1875	144.1870	128.1956	120.4190	135.8687	136.8056	153.8246	165.3798	178.5134	(219)
Water heating fuel used												1824.3741	(219)
Annual totals kWh/year													
Space heating fuel - main system												3632.7207	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	350.7552	(232)
Total delivered energy for all uses	5882.8500	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3632.7207	0.2160	784.6677	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.3741	0.2160	394.0648	(264)
Space and water heating			1178.7325	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Total CO2, kg/year			1399.6994	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.5400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.5400	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		36.0363	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		36.0363	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.7300	1.3258	19.5284			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.1800	13.5864			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.6162			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.6159	(36)
Total fabric heat loss (33) + (36) =	55.2321	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	96.6625	96.3751	96.0934	94.7700	94.5224	93.3698	93.3698	93.1564	93.8138	94.5224	95.0233	95.5469	(39)
Average = Sum(39)m / 12 =												94.7688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2116	1.2080	1.2045	1.1879	1.1848	1.1703	1.1703	1.1677	1.1759	1.1848	1.1911	1.1976	(40)
HLP (average)												1.1879	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.3480	383.9438	369.8475	347.4993	324.8144	302.9329	289.1310	295.7251	307.5157	330.0754	355.8972	375.1080	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(81)

Solar gains	90.2423	164.7916	254.8938	365.1362	453.9912	470.5058	445.3789	376.0624	292.5936	190.0619	110.1064	75.9234	(83)
Total gains	476.5902	548.7354	624.7413	712.6355	778.8055	773.4386	734.5099	671.7875	600.1093	520.1372	466.0036	451.0315	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.3157	57.4866	57.6552	58.4603	58.6134	59.3369	59.3369	59.4729	59.0561	58.6134	58.3044	57.9849	
alpha	4.8210	4.8324	4.8437	4.8974	4.9076	4.9558	4.9558	4.9649	4.9371	4.9076	4.8870	4.8657	
util living area													
	0.9980	0.9957	0.9886	0.9608	0.8768	0.7103	0.5450	0.6113	0.8614	0.9788	0.9960	0.9985	(86)
MIT	19.6745	19.8290	20.0958	20.4598	20.7705	20.9435	20.9877	20.9790	20.8473	20.4456	19.9990	19.6522	(87)
Th 2	19.9107	19.9136	19.9164	19.9297	19.9322	19.9438	19.9438	19.9460	19.9393	19.9322	19.9272	19.9219	(88)
util rest of house													
	0.9974	0.9943	0.9843	0.9456	0.8304	0.6170	0.4215	0.4842	0.7915	0.9679	0.9944	0.9980	(89)
MIT 2	18.1483	18.3758	18.7653	19.2937	19.7070	19.9064	19.9393	19.9373	19.8144	19.2834	18.6342	18.1236	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.4636	18.6760	19.0401	19.5346	19.9267	20.1206	20.1559	20.1525	20.0277	19.5235	18.9161	18.4394	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4636	18.6760	19.0401	19.5346	19.9267	20.1206	20.1559	20.1525	20.0277	19.5235	18.9161	18.4394	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9917	0.9796	0.9384	0.8301	0.6338	0.4471	0.5104	0.7984	0.9621	0.9920	0.9969	(94)
Useful gains	474.6679	544.2067	611.9795	668.7146	646.4743	490.1918	328.4249	342.8889	479.1289	500.4097	462.2748	449.6290	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1369.0886	1327.6591	1205.0230	1007.8366	777.6058	515.4597	332.0124	349.5700	556.1039	843.4682	1122.8080	1360.5268	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	665.4490	526.4800	441.2244	244.1678	97.5619	0.0000	0.0000	0.0000	0.0000	255.2355	475.5839	677.7079	(98)
Space heating												3383.4104	(98)
Space heating per m2											(98) / (4) =	42.4093	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3622.4951	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	665.4490	526.4800	441.2244	244.1678	97.5619	0.0000	0.0000	0.0000	0.0000	255.2355	475.5839	677.7079	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	712.4722	563.6831	472.4030	261.4217	104.4560	0.0000	0.0000	0.0000	0.0000	273.2714	509.1905	725.5974	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8275	87.6237	87.1679	86.0573	83.8718	80.3000	80.3000	80.3000	80.3000	86.0498	87.3460	87.9075	(217)
Fuel for water heating, kWh/month													
	230.0005	202.3199	211.6016	190.1020	188.8482	173.7253	166.4421	185.5439	187.5930	199.3386	209.6323	224.3697	(219)
Water heating fuel used												2369.5171	(219)
Annual totals kWh/year													
Space heating fuel - main system												3622.4951	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Total delivered energy for all uses												6417.7674	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3622.4951	0.2160	782.4589	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2369.5171	0.2160	511.8157	(264)
Space and water heating			1294.2746	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Total CO2, kg/m2/year			1515.2416	(272)
Emissions per m2 for space and water heating			16.2230	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2818	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2230 * 1.00) + 2.2818 + 0.4879, rounded to 2 d.p.			18.9900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095	(36)
Total fabric heat loss	(33) + (36) =	57.6202	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	99.0694	98.7812	98.4987	97.1720	96.9238	95.7683	95.7683	95.5543	96.2134	96.9238	97.4260	97.9509	(39)
Average = Sum(39)m / 12 =												97.1708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2418	1.2382	1.2346	1.2180	1.2149	1.2004	1.2004	1.1977	1.2060	1.2149	1.2212	1.2278	(40)
HLP (average)												1.2180	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	341.8626	340.5473	328.6882	309.1535	288.5176	269.2625	257.1539	260.9442	271.3298	290.9996	313.6403	331.3914	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	446.4518	531.5378	624.1056	732.3398	814.6852	814.5702	773.3401	696.7938	610.4405	511.2779	441.2517	419.3853	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5298	33.6276	33.7240	34.1845	34.2720	34.6855	34.6855	34.7632	34.5251	34.2720	34.0954	33.9126	
alpha	3.2353	3.2418	3.2483	3.2790	3.2848	3.3124	3.3124	3.3175	3.3017	3.2848	3.2730	3.2608	
util living area													
	0.9894	0.9807	0.9606	0.9080	0.8038	0.6497	0.5091	0.5723	0.7986	0.9439	0.9827	0.9913	(86)
MIT	18.9610	19.2009	19.6041	20.1358	20.5825	20.8578	20.9529	20.9307	20.7007	20.1104	19.4438	18.9247	(87)
Th 2	19.8867	19.8896	19.8924	19.9056	19.9081	19.9197	19.9197	19.9218	19.9152	19.9081	19.9031	19.8979	(88)
util rest of house													
	0.9871	0.9765	0.9517	0.8865	0.7574	0.5684	0.3981	0.4596	0.7330	0.9265	0.9782	0.9894	(89)
MIT 2	18.0314	18.2713	18.6708	19.1947	19.6059	19.8407	19.9026	19.8942	19.7251	19.1826	18.5242	18.0034	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2235	18.4633	18.8636	19.3891	19.8076	20.0508	20.1195	20.1083	19.9266	19.3743	18.7142	18.1937	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2235	18.4633	18.8636	19.3891	19.8076	20.0508	20.1195	20.1083	19.9266	19.3743	18.7142	18.1937	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9823	0.9693	0.9410	0.8742	0.7526	0.5791	0.4197	0.4805	0.7338	0.9155	0.9715	0.9853	(94)
Useful gains	438.5343	515.2028	587.2618	640.2196	613.1369	471.6878	324.5655	334.8118	447.9697	468.0652	428.6830	413.2242	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1379.3883	1339.7999	1217.7994	1019.2446	785.8229	522.0142	337.0599	354.3418	560.6003	850.4342	1131.5229	1370.6975	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	699.9954	554.1292	469.1199	272.8981	128.4783	0.0000	0.0000	0.0000	0.0000	284.4826	506.0447	712.3601	(98)
Space heating												3627.5083	(98)
Space heating per m2											(98) / (4) =	45.4689	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calculated for June, July and August. See Table 10b												
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	900.2219	708.6853	726.2127	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8214	0.8780	0.8451	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	739.4563	622.2291	613.7306	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1043.8684	993.7907	905.8929	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	219.1767	276.4419	217.3688	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												712.9873	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	54.7942	69.1105	54.3422	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												178.2468	(107)
Space cooling per m2												2.2342	(108)
Energy for space heating												45.4689	(99)
Energy for space cooling												2.2342	(108)
Total												47.7031	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.7300	1.3258	19.5284			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.1800	13.5864			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.6162			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.6159	(36)
Total fabric heat loss (33) + (36) =	55.2321	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	96.6625	96.3751	96.0934	94.7700	94.5224	93.3698	93.3698	93.1564	93.8138	94.5224	95.0233	95.5469	(39)
Average = Sum(39)m / 12 =												94.7688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2116	1.2080	1.2045	1.1879	1.1848	1.1703	1.1703	1.1677	1.1759	1.1848	1.1911	1.1976	(40)
HLP (average)												1.1879	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8612	17.6406	14.3463	10.8610	8.1188	6.8542	7.4062	9.6269	12.9212	16.4064	19.1487	20.4132	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	341.8626	340.5473	328.6882	309.1535	288.5176	269.2625	257.1539	260.9442	271.3298	290.9996	313.6403	331.3914	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)
Northwest	2.1600	11.2829	0.6300	0.7000	0.7700	7.4481	(81)

Solar gains	90.2423	164.7916	254.8938	365.1362	453.9912	470.5058	445.3789	376.0624	292.5936	190.0619	110.1064	75.9234	(83)
Total gains	432.1049	505.3389	583.5820	674.2897	742.5087	739.7682	702.5328	637.0066	563.9234	481.0615	423.7467	407.3148	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.3157	57.4866	57.6552	58.4603	58.6134	59.3369	59.3369	59.4729	59.0561	58.6134	58.3044	57.9849	
alpha	4.8210	4.8324	4.8437	4.8974	4.9076	4.9558	4.9558	4.9649	4.9371	4.9076	4.8870	4.8657	
util living area													
	0.9987	0.9970	0.9914	0.9680	0.8925	0.7329	0.5671	0.6388	0.8834	0.9845	0.9974	0.9991	(86)
MIT	19.6232	19.7794	20.0502	20.4225	20.7469	20.9350	20.9854	20.9746	20.8252	20.4041	19.9505	19.6016	(87)
Th 2	19.9107	19.9136	19.9164	19.9297	19.9322	19.9438	19.9438	19.9460	19.9393	19.9322	19.9272	19.9219	(88)
util rest of house													
	0.9983	0.9960	0.9881	0.9551	0.8496	0.6400	0.4399	0.5088	0.8193	0.9761	0.9963	0.9987	(89)
MIT 2	18.6562	18.8144	19.0858	19.4606	19.7599	19.9139	19.9401	19.9386	19.8388	19.4496	18.9962	18.6435	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8560	19.0137	19.2850	19.6593	19.9638	20.1248	20.1560	20.1526	20.0426	19.6468	19.1934	18.8414	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8560	19.0137	19.2850	19.6593	19.9638	20.1248	20.1560	20.1526	20.0426	19.6468	19.1934	18.8414	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9947	0.9856	0.9510	0.8511	0.6573	0.4665	0.5358	0.8268	0.9731	0.9952	0.9982	(94)
Useful gains	431.0935	502.6771	575.1494	641.2739	631.9205	486.2344	327.7087	341.3339	466.2316	468.1245	421.6995	406.6013	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1407.0185	1360.2111	1228.5567	1019.6583	781.1106	515.8503	332.0264	349.5830	557.4945	855.1243	1149.1503	1398.9424	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	726.0882	576.2628	486.1350	272.4367	110.9974	0.0000	0.0000	0.0000	0.0000	287.9278	523.7646	738.3018	(98)
Space heating												3721.9144	(98)
Space heating per m2											(98) / (4) =	46.6522	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	877.6761	690.9365	707.9883	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8657	0.9240	0.8933	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	759.8295	638.4217	632.4644	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	956.4375	911.0290	836.0118	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	141.5577	202.8198	151.4392	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												495.8168	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	35.3894	50.7050	37.8598	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												123.9542 (107)
Space cooling per m2												1.5537 (108)
Energy for space heating												46.6522 (99)
Energy for space cooling												1.5537 (108)
Total												48.2059 (109)
Target Fabric Energy Efficiency (TFEE)												55.4 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	97.9894	97.3999	97.3999	96.5695	96.5695	95.5630	95.8038	95.3293	95.5630	96.0519	96.0519	96.8391	(39)
Average = Sum(39)m / 12 =												96.4275	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2282	1.2209	1.2209	1.2104	1.2104	1.1978	1.2009	1.1949	1.1978	1.2040	1.2040	1.2138	(40)
HLP (average)												1.2087	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(75)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northwest	2.1600	12.9236	0.4600	0.0000	0.7700	9.8875	(81)
Northeast	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(75)

Solar gains	116.7969	192.6491	296.0462	439.1443	532.8851	591.1142	553.4874	477.4847	369.1766	237.7451	146.1451	97.2226	(83)
Total gains	669.9177	741.4648	823.6261	933.7642	993.7517	1021.7016	966.3350	898.5161	809.1328	710.8727	656.1692	635.1687	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8993	34.1045	34.1045	34.3977	34.3977	34.7600	34.6727	34.8452	34.7600	34.5831	34.5831	34.3020	
alpha	3.2600	3.2736	3.2736	3.2932	3.2932	3.3173	3.3115	3.3230	3.3173	3.3055	3.3055	3.2868	
util living area	0.9626	0.9470	0.9081	0.8170	0.6631	0.4469	0.3030	0.3333	0.6086	0.8499	0.9397	0.9673	(86)
MIT	19.4592	19.6513	20.0251	20.4761	20.8075	20.9639	20.9929	20.9904	20.8948	20.4928	19.9267	19.4328	(87)
Th 2	19.8975	19.9034	19.9034	19.9117	19.9117	19.9217	19.9193	19.9241	19.9217	19.9168	19.9168	19.9090	(88)
util rest of house	0.9549	0.9364	0.8892	0.7802	0.5990	0.3584	0.1994	0.2241	0.5190	0.8104	0.9254	0.9605	(89)
MIT 2	17.8951	18.1730	18.7014	19.3201	19.7325	19.9002	19.9174	19.9213	19.8438	19.3628	18.5802	17.8649	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2182	18.4783	18.9748	19.5589	19.9546	20.1199	20.1396	20.1422	20.0609	19.5962	18.8584	18.1888	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0682	18.3283	18.8248	19.4089	19.8046	19.9699	19.9896	19.9922	19.9109	19.4462	18.7084	18.0388	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9160	0.8659	0.7606	0.5922	0.3625	0.2063	0.2312	0.5180	0.7896	0.9042	0.9441	(94)
Useful gains	627.8741	679.1486	713.1789	710.2338	588.4807	370.3373	199.3271	207.7151	419.1642	561.3371	593.3321	599.6644	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1270.7443	1239.7389	1112.7747	918.2678	657.1126	379.3798	200.1923	208.9770	450.1910	753.6425	1028.5595	1252.9803	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	478.2954	376.7167	297.2993	149.7845	51.0622	0.0000	0.0000	0.0000	0.0000	143.0752	313.3637	486.0671	(98)

Space heating 2295.6641 (98)
RHI space heating demand 2296 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b)	= 101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c)	= 104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		= 0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		= 0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095	(36)
Total fabric heat loss	(33) + (36) =	57.6202	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	100.9982	100.6351	100.2792	98.6077	98.2949	96.8391	96.8391	96.5695	97.3999	98.2949	98.9276	99.5890	(39)
Average = Sum(39)m / 12 =												98.6062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2660	1.2614	1.2569	1.2360	1.2321	1.2138	1.2138	1.2104	1.2209	1.2321	1.2400	1.2483	(40)
HLP (average)												1.2360	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	657.7100	739.8062	822.9972	917.8062	987.0343	975.8951	929.0338	856.8810	779.0670	693.4059	637.6355	625.9400	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8894	33.0081	33.1252	33.6868	33.7939	34.3020	34.3020	34.3977	34.1045	33.7939	33.5778	33.3548	
alpha	3.1926	3.2005	3.2083	3.2458	3.2529	3.2868	3.2868	3.2932	3.2736	3.2529	3.2385	3.2237	
util living area													
	0.9692	0.9541	0.9231	0.8534	0.7347	0.5743	0.4388	0.4879	0.7066	0.8874	0.9537	0.9733	(86)
MIT	19.2470	19.4704	19.8372	20.3098	20.6815	20.8995	20.9688	20.9557	20.7945	20.3141	19.7099	19.2143	(87)
Th 2	19.8676	19.8712	19.8747	19.8913	19.8944	19.9090	19.9090	19.9117	19.9034	19.8944	19.8881	19.8816	(88)
util rest of house													
	0.9630	0.9450	0.9075	0.8237	0.6822	0.4944	0.3380	0.3842	0.6322	0.8577	0.9429	0.9679	(89)
MIT 2	17.5700	17.8927	18.4169	19.0827	19.5682	19.8305	19.8930	19.8872	19.7233	19.1072	18.2526	17.5317	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9164	18.2186	18.7103	19.3362	19.7982	20.0513	20.1153	20.1079	19.9445	19.3565	18.5537	17.8792	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7664	18.0686	18.5603	19.1862	19.6482	19.9013	19.9653	19.9579	19.7945	19.2065	18.4037	17.7292	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9467	0.9252	0.8841	0.8012	0.6691	0.4938	0.3434	0.3889	0.6239	0.8345	0.9232	0.9529	(94)
Useful gains	622.6494	684.4388	727.6506	735.3059	660.4235	481.9107	319.0491	333.2288	486.0553	578.6781	588.6713	596.4755	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1360.0826	1325.2270	1209.3989	1014.2955	781.2635	513.3764	325.8879	343.5832	554.6484	845.9747	1118.2435	1347.3646	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	548.6503	430.6097	358.4208	200.8726	89.9049	0.0000	0.0000	0.0000	0.0000	198.8686	381.2920	558.6615	(98)
Space heating												2767.2804	(98)
Space heating per m2											(98) / (4) =	34.6864	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3057.7684	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	548.6503	430.6097	358.4208	200.8726	89.9049	0.0000	0.0000	0.0000	0.0000	198.8686	381.2920	558.6615	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	606.2434	475.8118	396.0450	221.9586	99.3425	0.0000	0.0000	0.0000	0.0000	219.7443	421.3172	617.3055	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7389	89.6727	89.5300	89.2009	88.5923	87.3000	87.3000	87.3000	87.3000	89.1643	89.5804	89.7661	(217)
Fuel for water heating, kWh/month													
	184.0494	161.5222	167.9725	148.4502	144.5178	128.1956	120.4190	135.8687	136.8056	154.1406	165.5868	178.6716	(219)
Water heating fuel used												1826.1999	(219)
Annual totals kWh/year													
Space heating fuel - main system												3057.7684	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Total delivered energy for all uses												5309.7235	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3057.7684	3.4800	106.4103	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.1999	3.4800	63.5518	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	350.7552	13.1900	46.2646	(250)
Additional standing charges			120.0000	(251)
Total energy cost			346.1192	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1650	(257)
SAP value		83.7481	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3057.7684	0.2160	660.4780	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.1999	0.2160	394.4592	(264)
Space and water heating			1054.9372	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Total kg/year			1275.9041	(272)
CO2 emissions per m2			15.9900	(273)
EI value			86.2982	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	97.9894	97.3999	97.3999	96.5695	96.5695	95.5630	95.8038	95.3293	95.5630	96.0519	96.0519	96.8391	(39)
Average = Sum(39)m / 12 =												96.4275	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2282	1.2209	1.2209	1.2104	1.2104	1.1978	1.2009	1.1949	1.1978	1.2040	1.2040	1.2138	(40)
HLP (average)												1.2087	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(75)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northwest	2.1600	12.9236	0.4600	0.0000	0.7700	9.8875	(81)
Northeast	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(75)

Solar gains	116.7969	192.6491	296.0462	439.1443	532.8851	591.1142	553.4874	477.4847	369.1766	237.7451	146.1451	97.2226	(83)
Total gains	669.9177	741.4648	823.6261	933.7642	993.7517	1021.7016	966.3350	898.5161	809.1328	710.8727	656.1692	635.1687	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8993	34.1045	34.1045	34.3977	34.3977	34.7600	34.6727	34.8452	34.7600	34.5831	34.5831	34.3020	
alpha	3.2600	3.2736	3.2736	3.2932	3.2932	3.3173	3.3115	3.3230	3.3173	3.3055	3.3055	3.2868	
util living area													
	0.9626	0.9470	0.9081	0.8170	0.6631	0.4469	0.3030	0.3333	0.6086	0.8499	0.9397	0.9673	(86)
MIT	19.4592	19.6513	20.0251	20.4761	20.8075	20.9639	20.9929	20.9904	20.8948	20.4928	19.9267	19.4328	(87)
Th 2	19.8975	19.9034	19.9034	19.9117	19.9117	19.9217	19.9193	19.9241	19.9217	19.9168	19.9168	19.9090	(88)
util rest of house													
	0.9549	0.9364	0.8892	0.7802	0.5990	0.3584	0.1994	0.2241	0.5190	0.8104	0.9254	0.9605	(89)
MIT 2	17.8951	18.1730	18.7014	19.3201	19.7325	19.9002	19.9174	19.9213	19.8438	19.3628	18.5802	17.8649	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2182	18.4783	18.9748	19.5589	19.9546	20.1199	20.1396	20.1422	20.0609	19.5962	18.8584	18.1888	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0682	18.3283	18.8248	19.4089	19.8046	19.9699	19.9896	19.9922	19.9109	19.4462	18.7084	18.0388	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9160	0.8659	0.7606	0.5922	0.3625	0.2063	0.2312	0.5180	0.7896	0.9042	0.9441	(94)
Useful gains	627.8741	679.1486	713.1789	710.2338	588.4807	370.3373	199.3271	207.7151	419.1642	561.3371	593.3321	599.6644	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1270.7443	1239.7389	1112.7747	918.2678	657.1126	379.3798	200.1923	208.9770	450.1910	753.6425	1028.5595	1252.9803	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	478.2954	376.7167	297.2993	149.7845	51.0622	0.0000	0.0000	0.0000	0.0000	143.0752	313.3637	486.0671	(98)
Space heating												2295.6641	(98)
Space heating per m2											(98) / (4) =	28.7749	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2536.6454	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	478.2954	376.7167	297.2993	149.7845	51.0622	0.0000	0.0000	0.0000	0.0000	143.0752	313.3637	486.0671	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	528.5032	416.2615	328.5075	165.5078	56.4223	0.0000	0.0000	0.0000	0.0000	158.0942	346.2583	537.0907	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6564	89.5880	89.3992	88.9697	88.1891	87.3000	87.3000	87.3000	87.3000	88.9034	89.4466	89.6844	(217)
Fuel for water heating, kWh/month													
	184.2186	161.6747	168.2183	148.8360	145.1786	128.1956	120.4190	135.8687	136.8056	154.5931	165.8343	178.8343	(219)
Water heating fuel used												1828.6768	(219)
Annual totals kWh/year													
Space heating fuel - main system												2536.6454	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Total delivered energy for all uses												4791.0774	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2536.6454	3.9200	99.4365	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.6768	3.9200	71.6841	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	350.7552	16.9600	59.4881	(250)
Additional standing charges			88.0000	(251)
Total energy cost			331.3287	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2536.6454	0.2160	547.9154	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.6768	0.2160	394.9942	(264)
Space and water heating			942.9096	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Total kg/year			1163.8765	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2536.6454	1.2200	3094.7074	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.6768	1.2200	2230.9857	(264)
Space and water heating			5325.6931	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	350.7552	3.0700	1076.8184	(268)
Primary energy kWh/year			6632.7615	(272)
Primary energy kWh/m2/year			83.1381	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.6%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (96.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£72	£81	-£8
Mains gas	£259	£221	£38
Space heating	£200	£200	£0
Water heating	£72	£43	£29
Lighting	£59	£59	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£331	-£7	£339
Total cost of uses	£331	-£7	£338
Delivered energy	60 kWh/m²	26 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	0 kg/m²	14 kg/m²
Primary energy	83 kWh/m²	0 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	100.9982	100.6351	100.2792	98.6077	98.2949	96.8391	96.8391	96.5695	97.3999	98.2949	98.9276	99.5890	(39)
Average = Sum(39)m / 12 =												98.6062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2660	1.2614	1.2569	1.2360	1.2321	1.2138	1.2138	1.2104	1.2209	1.2321	1.2400	1.2483	(40)
HLP (average)												1.2360	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector		3.0000 (H1)
Zero-loss collector efficiency		0.7000 (H2)
Collector heat loss coefficient		1.8000 (H3)
Collector 2nd order heat loss coefficient		0.0050 (H3a)
Collector effective heat loss coefficient		1.8063 (H3b)
Collector performance ratio		2.5804 (H4)
Annual solar radiation per m2		1079.5246 (H5)
Overshading factor		0.8000 (H6)
Solar energy available		1813.6014 (H7)
Adjustment factor for showers		1.0000 (H7a)
Solar-to-load ratio		1.2449 (H8)
Utilisation factor		0.5521 (H9)
Collector performance factor		0.8793 (H10)
Dedicated solar storage volume		75.0000 (H11)
Effective solar volume		75.0000 (H13)
Daily hot water demand		92.5935 (H14)
Volume ratio Veff/V		0.8100 (H15)
Solar storage volume factor		0.9579 (H16)
Solar input		-843.3953 (H17)

Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662 (63)
								Solar input (sum of months) = Sum(63)m =				-843.3953 (63)
Output from w/h												
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)
								Total per year (kWh/year) = Sum(64)m =				786.4412 (64)
Heat gains from water heating, kWh/month												
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northwest	2.1600	11.2829	0.4600	0.0000	0.7700	8.6323	(81)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	104.5892	190.9905	295.4174	423.1863	526.1677	545.3078	516.1862	435.8496	339.1107	220.2783	127.6114	87.9939	(83)
Total gains	657.7100	739.8062	822.9972	917.8062	987.0343	975.8951	929.0338	856.8810	779.0670	693.4059	637.6355	625.9400	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.8894	33.0081	33.1252	33.6868	33.7939	34.3020	34.3020	34.3977	34.1045	33.7939	33.5778	33.3548	
alpha	3.1926	3.2005	3.2083	3.2458	3.2529	3.2868	3.2868	3.2932	3.2736	3.2529	3.2385	3.2237	
util living area													
	0.9692	0.9541	0.9231	0.8534	0.7347	0.5743	0.4388	0.4879	0.7066	0.8874	0.9537	0.9733	(86)
MIT	19.2470	19.4704	19.8372	20.3098	20.6815	20.8995	20.9688	20.9557	20.7945	20.3141	19.7099	19.2143	(87)
Th 2	19.8676	19.8712	19.8747	19.8913	19.8944	19.9090	19.9090	19.9117	19.9034	19.8944	19.8881	19.8816	(88)
util rest of house													
	0.9630	0.9450	0.9075	0.8237	0.6822	0.4944	0.3380	0.3842	0.6322	0.8577	0.9429	0.9679	(89)
MIT 2	17.5700	17.8927	18.4169	19.0827	19.5682	19.8305	19.8930	19.8872	19.7233	19.1072	18.2526	17.5317	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9164	18.2186	18.7103	19.3362	19.7982	20.0513	20.1153	20.1079	19.9445	19.3565	18.5537	17.8792	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7664	18.0686	18.5603	19.1862	19.6482	19.9013	19.9653	19.9579	19.7945	19.2065	18.4037	17.7292	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9467	0.9252	0.8841	0.8012	0.6691	0.4938	0.3434	0.3889	0.6239	0.8345	0.9232	0.9529	(94)
Useful gains	622.6494	684.4388	727.6506	735.3059	660.4235	481.9107	319.0491	333.2288	486.0553	578.6781	588.6713	596.4755	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1360.0826	1325.2270	1209.3989	1014.2955	781.2635	513.3764	325.8879	343.5832	554.6484	845.9747	1118.2435	1347.3646	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	548.6503	430.6097	358.4208	200.8726	89.9049	0.0000	0.0000	0.0000	0.0000	198.8686	381.2920	558.6615	(98)
Space heating												2767.2804	(98)
Space heating per m2											(98) / (4) =	34.6864	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3057.7684	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	548.6503	430.6097	358.4208	200.8726	89.9049	0.0000	0.0000	0.0000	0.0000	198.8686	381.2920	558.6615	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	606.2434	475.8118	396.0450	221.9586	99.3425	0.0000	0.0000	0.0000	0.0000	219.7443	421.3172	617.3055	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8279	89.8591	89.8933	89.9608	90.0843	87.3000	87.3000	87.3000	87.3000	89.5153	89.7162	89.8404	(217)
Fuel for water heating, kWh/month	156.6407	115.7700	89.9727	43.6487	14.3753	0.0000	0.0000	24.1300	49.2919	95.2536	133.0016	155.7432	(219)
Water heating fuel used												877.8277	(219)

Annual totals kWh/year		
Space heating fuel - main system	3057.7684	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	(233)
Total delivered energy for all uses	2684.1119	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3057.7684	3.4800	106.4103	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.8277	3.4800	30.5484	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	350.7552	13.1900	46.2646	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			91.8880	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3093	(257)
SAP value	95.6854	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3057.7684	0.2160	660.4780	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.8277	0.2160	189.6108	(264)
Space and water heating			850.0888	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			200.5684	(272)
CO2 emissions per m2			2.5100	(273)
EI value			97.8461	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.2200	1.2357	12.6293			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	16.8600	75.4800	0.2500	18.8700	52.3000	3947.6040	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.0107			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11958.3840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		149.8920 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6095 (36)
Total fabric heat loss	(33) + (36) =	57.6202 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	97.9894	97.3999	97.3999	96.5695	96.5695	95.5630	95.8038	95.3293	95.5630	96.0519	96.0519	96.8391	(39)
Average = Sum(39)m / 12 =												96.4275	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2282	1.2209	1.2209	1.2104	1.2104	1.1978	1.2009	1.1949	1.1978	1.2040	1.2040	1.2138	(40)
HLP (average)												1.2087	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1140.0998 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1915.3676 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3147 (H8)
Utilisation factor	0.5326 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-859.2180 (H17)

Solar input	-26.4463	-39.7487	-66.9419	-92.5342	-111.4423	-117.2882	-114.4719	-102.2241	-79.7862	-54.2771	-32.1462	-21.9109 (63)

Solar input (sum of months) = Sum(63)m = -859.2180 (63)

Output from w/h

	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756 (64)

Total per year (kWh/year) = Sum(64)m = 777.5864 (64)

Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6530	44.1014	35.8657	27.1526	20.2969	17.1355	18.5155	24.0671	32.3029	41.0159	47.8716	51.0330 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.1208	548.8157	527.5799	494.6199	460.8666	430.5874	412.8476	421.0314	439.9562	473.1277	510.0241	537.9461 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.0000	12.9236	0.4600	0.0000	0.7700	13.7326	(75)
Southwest	5.0600	40.4699	0.4600	0.0000	0.7700	72.5323	(79)
Northwest	2.1600	12.9236	0.4600	0.0000	0.7700	9.8875	(81)
Northeast	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(75)

Solar gains	116.7969	192.6491	296.0462	439.1443	532.8851	591.1142	553.4874	477.4847	369.1766	237.7451	146.1451	97.2226 (83)
Total gains	669.9177	741.4648	823.6261	933.7642	993.7517	1021.7016	966.3350	898.5161	809.1328	710.8727	656.1692	635.1687 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.8993	34.1045	34.1045	34.3977	34.3977	34.7600	34.6727	34.8452	34.7600	34.5831	34.5831	34.3020	
alpha	3.2600	3.2736	3.2736	3.2932	3.2932	3.3173	3.3115	3.3230	3.3173	3.3055	3.3055	3.2868	
util living area	0.9626	0.9470	0.9081	0.8170	0.6631	0.4469	0.3030	0.3333	0.6086	0.8499	0.9397	0.9673	(86)
MIT	19.4592	19.6513	20.0251	20.4761	20.8075	20.9639	20.9929	20.9904	20.8948	20.4928	19.9267	19.4328	(87)
Th 2	19.8975	19.9034	19.9034	19.9117	19.9117	19.9217	19.9193	19.9241	19.9217	19.9168	19.9168	19.9090	(88)
util rest of house	0.9549	0.9364	0.8892	0.7802	0.5990	0.3584	0.1994	0.2241	0.5190	0.8104	0.9254	0.9605	(89)
MIT 2	17.8951	18.1730	18.7014	19.3201	19.7325	19.9002	19.9174	19.9213	19.8438	19.3628	18.5802	17.8649	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2182	18.4783	18.9748	19.5589	19.9546	20.1199	20.1396	20.1422	20.0609	19.5962	18.8584	18.1888	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0682	18.3283	18.8248	19.4089	19.8046	19.9699	19.9896	19.9922	19.9109	19.4462	18.7084	18.0388	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9160	0.8659	0.7606	0.5922	0.3625	0.2063	0.2312	0.5180	0.7896	0.9042	0.9441	(94)
Useful gains	627.8741	679.1486	713.1789	710.2338	588.4807	370.3373	199.3271	207.7151	419.1642	561.3371	593.3321	599.6644	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1270.7443	1239.7389	1112.7747	918.2678	657.1126	379.3798	200.1923	208.9770	450.1910	753.6425	1028.5595	1252.9803	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	478.2954	376.7167	297.2993	149.7845	51.0622	0.0000	0.0000	0.0000	0.0000	143.0752	313.3637	486.0671	(98)
Space heating												2295.6641	(98)
Space heating per m2											(98) / (4) =	28.7749	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2536.6454	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	478.2954	376.7167	297.2993	149.7845	51.0622	0.0000	0.0000	0.0000	0.0000	143.0752	313.3637	486.0671	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	528.5032	416.2615	328.5075	165.5078	56.4223	0.0000	0.0000	0.0000	0.0000	158.0942	346.2583	537.0907	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7603	89.7822	89.7788	89.8078	89.6938	87.3000	87.3000	87.3000	87.3000	89.2968	89.6115	89.7704	(217)
Fuel for water heating, kWh/month	154.5423	117.0528	92.9439	44.4113	18.4955	0.0000	0.0000	18.7735	45.4125	93.1291	129.6564	154.2552	(219)
Water heating fuel used												868.6724	(219)
Annual totals kWh/year													
Space heating fuel - main system												2536.6454	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												350.7552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												2056.9134	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2536.6454	3.9200	99.4365	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.6724	3.9200	34.0520	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	350.7552	16.9600	59.4881	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-7.2009	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2536.6454	0.2160	547.9154	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.6724	0.2160	187.6332	(264)
Space and water heating			735.5487	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	350.7552	0.5190	182.0419	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			35.7267	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2536.6454	1.2200	3094.7074	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.6724	1.2200	1059.7803	(264)
Space and water heating			4154.4878	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	350.7552	3.0700	1076.8184	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			14.8861	(272)
Primary energy kWh/m2/year			0.1866	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	149.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	57.62	(37)
Summer heat loss coefficient	329.85	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.0000	98.8453	0.4600	0.0000	0.9000	122.7658
South West	5.0600	119.9223	0.4600	0.0000	0.9000	251.2181
North West	2.1600	98.8453	0.4600	0.0000	0.9000	88.3914
North East	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						646.9333

	Jun	Jul	Aug	
Solar gains	691	647	558	(P4)
Internal gains	428	410	418	
Total summer gains	1119	1057	976	(P5)
Summer gain/loss ratio	3.39	3.20	2.96	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 149.9)	0.95	0.95	0.95	
Threshold temperature	20.34	22.05	21.71	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-338	**Issued on Date**	19/10/2022
Assessment Reference	Plot 338	**Prop Type Ref**	Badlesmere-As-END
Property	Plot 338, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.13	**TER**	18.50
Environmental	87 B	**% DER<TER**	7.39		
CO_2 Emissions (t/year)	1.14	**DFEE**	45.46	**TFEE**	52.50
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.42		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

End-Terrace House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.50 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.13 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.5 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 7.51 m², No overhang
Windows facing South West: 0.72 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	501.7960	596.0450	682.7893	768.3890	825.3948	812.4274	775.0047	720.1572	657.9433	571.1308	498.0725	471.3869	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9855	0.9740	0.9509	0.8979	0.7991	0.6491	0.5059	0.5555	0.7703	0.9269	0.9760	0.9881	(86)
MIT	19.0539	19.3053	19.6926	20.1870	20.5976	20.8620	20.9553	20.9386	20.7405	20.1985	19.5433	19.0198	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9824	0.9685	0.9401	0.8746	0.7522	0.5680	0.3958	0.4449	0.7012	0.9053	0.9700	0.9855	(89)
MIT 2	17.3019	17.6680	18.2272	18.9348	19.4865	19.8143	19.9026	19.8936	19.6841	18.9672	18.0269	17.2608	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6638	18.0062	18.5299	19.1934	19.7160	20.0308	20.1201	20.1095	19.9023	19.2216	18.3402	17.6241	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5138	17.8562	18.3799	19.0434	19.5660	19.8808	19.9701	19.9595	19.7523	19.0716	18.1902	17.4741	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9539	0.9202	0.8516	0.7350	0.5642	0.4006	0.4483	0.6887	0.8832	0.9561	0.9767	(94)
Useful gains	487.8506	568.5514	628.2746	654.3955	606.6454	458.3773	310.4638	322.8400	453.1393	504.4096	476.1904	460.4068	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1311.6001	1281.3217	1170.6567	982.5845	759.5146	502.2037	320.4977	337.5504	540.7093	817.9827	1077.8438	1298.8792	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	612.8696	478.9817	403.5323	236.2961	113.7347	0.0000	0.0000	0.0000	0.0000	233.2984	433.1904	623.8235	(98)
Space heating												3135.7266	(98)
Space heating per m2											(98) / (4) =	39.3047	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3464.8913	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	612.8696	478.9817	403.5323	236.2961	113.7347	0.0000	0.0000	0.0000	0.0000	233.2984	433.1904	623.8235	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	677.2040	529.2615	445.8920	261.1007	125.6737	0.0000	0.0000	0.0000	0.0000	257.7882	478.6635	689.3077	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8012	89.7363	89.6082	89.3241	88.7767	87.3000	87.3000	87.3000	87.3000	89.2867	89.6617	89.8266	(217)
Fuel for water heating, kWh/month													
	183.9216	161.4077	167.8259	148.2455	144.2176	128.1956	120.4190	135.8687	136.8056	153.9293	165.4366	178.5512	(219)
Water heating fuel used												1824.8242	(219)
Annual totals kWh/year													
Space heating fuel - main system												3464.8913	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5721.6282	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3464.8913	0.2160	748.4165	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.8242	0.2160	394.1620	(264)
Space and water heating			1142.5786	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1366.7412	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.1300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.1300	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.6263	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.6263	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	109.9916	193.1519	279.6728	372.3307	440.5928	447.7661	427.3832	374.8728	311.5114	217.6246	132.8000	93.4470	(83)
Total gains	496.6883	577.4054	649.7721	720.0207	765.5497	750.8193	716.6442	670.7669	619.2540	547.9880	489.0334	468.9134	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9976	0.9946	0.9863	0.9578	0.8778	0.7162	0.5472	0.6020	0.8433	0.9732	0.9950	0.9982	(86)
MIT	19.7307	19.8940	20.1528	20.4915	20.7785	20.9445	20.9884	20.9817	20.8690	20.4959	20.0534	19.7062	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9968	0.9928	0.9813	0.9417	0.8320	0.6242	0.4255	0.4781	0.7704	0.9599	0.9930	0.9976	(89)
MIT 2	18.2444	18.4844	18.8617	19.3529	19.7344	19.9270	19.9597	19.9586	19.8544	19.3683	18.7275	18.2165	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5514	18.7756	19.1284	19.5881	19.9501	20.1372	20.1722	20.1699	20.0640	19.6013	19.0014	18.5243	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5514	18.7756	19.1284	19.5881	19.9501	20.1372	20.1722	20.1699	20.0640	19.6013	19.0014	18.5243	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9899	0.9762	0.9348	0.8319	0.6408	0.4507	0.5037	0.7788	0.9539	0.9903	0.9964	(94)
Useful gains	494.3401	571.5852	634.2787	673.0433	636.8640	481.1135	323.0045	337.8494	482.2926	522.7404	484.2943	467.2213	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1349.1222	1309.5523	1188.2896	991.5654	763.3452	505.9492	326.4037	343.6666	547.5953	832.8467	1107.1433	1340.0354	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	635.9579	495.9139	412.1841	229.3359	94.1020	0.0000	0.0000	0.0000	0.0000	230.7191	448.4513	649.3737	(98)
Space heating												3196.0378	(98)
Space heating per m2											(98) / (4) =	40.0606	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3421.8820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	635.9579	495.9139	412.1841	229.3359	94.1020	0.0000	0.0000	0.0000	0.0000	230.7191	448.4513	649.3737	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	680.8971	530.9570	441.3106	245.5417	100.7516	0.0000	0.0000	0.0000	0.0000	247.0226	480.1406	695.2609	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7397	87.5017	87.0164	85.9015	83.7889	80.3000	80.3000	80.3000	80.3000	85.7982	87.2194	87.8264	(217)
Fuel for water heating, kWh/month													
	230.2308	202.6021	211.9699	190.4467	189.0350	173.7253	166.4421	185.5439	187.5930	199.9232	209.9365	224.5768	(219)
Water heating fuel used												2372.0253	(219)
Annual totals kWh/year													
Space heating fuel - main system												3421.8820	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6225.8200	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3421.8820	0.2160	739.1265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2372.0253	0.2160	512.3575	(264)
Space and water heating			1251.4840	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1475.6466	(272)
Emissions per m2 for space and water heating			15.6867	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6867 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.5000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	469.6896	564.7166	653.0758	740.8688	799.2992	788.3357	752.6134	695.5841	632.5928	543.5107	467.8893	440.0531	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9880	0.9774	0.9556	0.9045	0.8073	0.6584	0.5142	0.5668	0.7820	0.9343	0.9798	0.9902	(86)
MIT	19.0446	19.2972	19.6861	20.1789	20.5931	20.8592	20.9545	20.9364	20.7329	20.1825	19.5245	19.0049	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9854	0.9726	0.9457	0.8824	0.7616	0.5779	0.4039	0.4560	0.7148	0.9146	0.9746	0.9881	(89)
MIT 2	18.1262	18.3782	18.7629	19.2484	19.6302	19.8585	19.9205	19.9139	19.7647	19.2633	18.6158	18.0950	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3159	18.5681	18.9536	19.4406	19.8291	20.0652	20.1340	20.1252	19.9647	19.4532	18.8035	18.2829	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3159	18.5681	18.9536	19.4406	19.8291	20.0652	20.1340	20.1252	19.9647	19.4532	18.8035	18.2829	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9801	0.9647	0.9348	0.8706	0.7570	0.5884	0.4254	0.4767	0.7171	0.9036	0.9674	0.9837	(94)
Useful gains	460.3625	544.7766	610.4725	645.0206	605.0715	463.8812	320.1586	331.5642	453.6449	491.1290	452.6307	432.8642	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1364.1780	1326.3849	1205.0110	1005.9283	773.7709	513.8881	332.3052	349.4786	554.0635	842.6905	1119.8784	1354.9522	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	672.4388	525.2408	442.3366	259.8536	125.5124	0.0000	0.0000	0.0000	0.0000	261.5617	480.4183	686.0335	(98)
Space heating												3453.3956	(98)
Space heating per m2											(98) / (4) =	43.2865	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8208	0.8794	0.8534	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	725.4729	611.9355	608.5042	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1013.3648	969.7378	904.7039	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	207.2822	266.2049	220.3726	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												693.8597	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	51.8205	66.5512	55.0932	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												173.4649	(107)
Space cooling per m2												2.1743	(108)
Energy for space heating												43.2865	(99)
Energy for space cooling												2.1743	(108)
Total												45.4608	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	109.9916	193.1519	279.6728	372.3307	440.5928	447.7661	427.3832	374.8728	311.5114	217.6246	132.8000	93.4470	(83)
Total gains	452.2029	534.0089	608.6129	681.6749	729.2529	717.1489	684.6671	635.9860	583.0680	508.9123	446.7765	425.1967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9985	0.9962	0.9895	0.9655	0.8939	0.7395	0.5700	0.6296	0.8666	0.9800	0.9967	0.9989	(86)
MIT	19.6793	19.8444	20.1076	20.4546	20.7548	20.9358	20.9861	20.9777	20.8490	20.4553	20.0049	19.6554	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9979	0.9949	0.9857	0.9519	0.8517	0.6482	0.4445	0.5026	0.7987	0.9696	0.9953	0.9985	(89)
MIT 2	18.7281	18.8950	19.1585	19.5080	19.7849	19.9342	19.9605	19.9597	19.8744	19.5153	19.0664	18.7132	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9246	19.0911	19.3545	19.7035	19.9853	20.1411	20.1723	20.1700	20.0757	19.7095	19.2603	18.9078	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9246	19.0911	19.3545	19.7035	19.9853	20.1411	20.1723	20.1700	20.0757	19.7095	19.2603	18.9078	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9934	0.9828	0.9479	0.8532	0.6651	0.4707	0.5290	0.8076	0.9664	0.9940	0.9979	(94)
Useful gains	450.9374	530.4905	598.1683	646.1725	622.1983	477.0035	322.2893	336.4477	470.8958	491.8343	444.0959	424.3159	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1384.4456	1339.3349	1209.5657	1002.2755	766.5973	506.3064	326.4131	343.6723	548.6728	842.8616	1131.2257	1375.9188	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.5301	543.5435	454.8797	256.3942	107.4329	0.0000	0.0000	0.0000	0.0000	261.1644	494.7334	707.9925	(98)
Space heating												3520.6706	(98)
Space heating per m2											(98) / (4) =	44.1297	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8659	0.9259	0.9020	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	743.7160	626.0361	624.9430	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	930.1594	890.3200	835.0439	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	134.2393	196.6272	156.3150	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												487.1815	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	33.5598	49.1568	39.0788	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												121.7954 (107)
Space cooling per m2												1.5266 (108)
Energy for space heating												44.1297 (99)
Energy for space cooling												1.5266 (108)
Total												45.6564 (109)
Target Fabric Energy Efficiency (TFEE)												52.5 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Southwest	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(79)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

Solar gains	141.1347	223.4224	320.9017	442.7854	512.5197	558.2244	526.7372	471.0504	388.3102	269.1356	174.6459	118.7073	(83)
Total gains	695.1272	773.0124	849.1112	937.8820	973.7426	989.1125	939.9098	892.5043	828.8335	742.9833	685.5104	657.5493	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9588	0.9409	0.9004	0.8124	0.6665	0.4534	0.3061	0.3300	0.5918	0.8336	0.9322	0.9641	(86)
MIT	19.5403	19.7373	20.0918	20.5065	20.8139	20.9648	20.9933	20.9915	20.9086	20.5457	20.0018	19.5106	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9504	0.9292	0.8804	0.7755	0.6031	0.3651	0.2031	0.2235	0.5040	0.7920	0.9166	0.9568	(89)
MIT 2	18.0210	18.3050	18.8046	19.3727	19.7555	19.9181	19.9350	19.9391	19.8720	19.4422	18.6960	17.9866	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3348	18.6009	19.0705	19.6069	19.9741	20.1343	20.1536	20.1565	20.0861	19.6701	18.9657	18.3014	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1848	18.4509	18.9205	19.4569	19.8241	19.9843	20.0036	20.0065	19.9361	19.5201	18.8157	18.1514	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9323	0.9085	0.8576	0.7567	0.5963	0.3690	0.2097	0.2301	0.5037	0.7729	0.8954	0.9400	(94)
Useful gains	648.0862	702.2970	728.2164	709.7379	580.6720	364.9863	197.0559	205.3780	417.4608	574.2153	613.7720	618.0852	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1259.4265	1229.3309	1102.0656	906.2914	647.1345	373.8261	197.8770	206.5054	444.3604	746.9735	1020.0689	1241.1988	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	454.8372	354.1668	278.1438	141.5185	49.4481	0.0000	0.0000	0.0000	0.0000	128.5322	292.5338	463.5965	(98)
Space heating												2162.7768	(98)
RHI space heating demand												2163	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	681.4708	773.4495	852.3453	926.6212	971.8621	949.8411	908.5021	855.9248	801.5595	726.0707	664.7774	647.1454	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9663	0.9485	0.9159	0.8484	0.7366	0.5800	0.4413	0.4820	0.6896	0.8741	0.9484	0.9709	(86)
MIT	19.3283	19.5617	19.9129	20.3492	20.6927	20.9021	20.9703	20.9599	20.8183	20.3763	19.7864	19.2930	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9596	0.9385	0.8993	0.8182	0.6846	0.5007	0.3415	0.3806	0.6152	0.8423	0.9366	0.9651	(89)
MIT 2	17.6965	18.0326	18.5332	19.1474	19.5964	19.8496	19.9112	19.9069	19.7628	19.2009	18.3711	17.6547	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0336	18.3485	18.8182	19.3957	19.8229	20.0670	20.1300	20.1244	19.9808	19.4437	18.6635	17.9931	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8836	18.1985	18.6682	19.2457	19.6729	19.9170	19.9800	19.9744	19.8308	19.2937	18.5135	17.8431	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9182	0.8761	0.7966	0.6719	0.5000	0.3466	0.3851	0.6083	0.8202	0.9165	0.9497	(94)
Useful gains	642.5043	710.1888	746.7080	738.1416	652.9838	474.9301	314.9243	329.6037	487.6052	595.5046	609.2634	614.6050	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1348.3029	1315.1753	1199.0636	1002.1757	769.8336	505.6501	321.4354	338.9656	548.2193	839.4354	1109.2654	1334.9856	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	525.1142	406.5509	336.5526	190.1046	86.9363	0.0000	0.0000	0.0000	0.0000	181.4845	360.0015	535.9632	(98)
Space heating												2622.7077	(98)
Space heating per m2											(98) / (4) =	32.8743	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2898.0196	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	525.1142	406.5509	336.5526	190.1046	86.9363	0.0000	0.0000	0.0000	0.0000	181.4845	360.0015	535.9632	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	580.2367	449.2275	371.8813	210.0603	96.0622	0.0000	0.0000	0.0000	0.0000	200.5354	397.7917	592.2245	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7132	89.6369	89.4870	89.1582	88.5665	87.3000	87.3000	87.3000	87.3000	89.0927	89.5422	89.7423	(217)
Fuel for water heating, kWh/month													
	184.1022	161.5866	168.0534	148.5213	144.5599	128.1956	120.4190	135.8687	136.8056	154.2646	165.6572	178.7189	(219)
Water heating fuel used												1826.7529	(219)
Annual totals kWh/year													
Space heating fuel - main system												2898.0196	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5156.6851	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2898.0196	3.4800	100.8511	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.7529	3.4800	63.5710	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			341.3914	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1491	(257)
SAP value		83.9701	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2898.0196	0.2160	625.9722	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.7529	0.2160	394.5786	(264)
Space and water heating			1020.5509	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1244.7135	(272)
CO2 emissions per m2			15.6000	(273)
EI value			86.6331	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Southwest	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(79)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

Solar gains	141.1347	223.4224	320.9017	442.7854	512.5197	558.2244	526.7372	471.0504	388.3102	269.1356	174.6459	118.7073	(83)
Total gains	695.1272	773.0124	849.1112	937.8820	973.7426	989.1125	939.9098	892.5043	828.8335	742.9833	685.5104	657.5493	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9588	0.9409	0.9004	0.8124	0.6665	0.4534	0.3061	0.3300	0.5918	0.8336	0.9322	0.9641	(86)
MIT	19.5403	19.7373	20.0918	20.5065	20.8139	20.9648	20.9933	20.9915	20.9086	20.5457	20.0018	19.5106	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9504	0.9292	0.8804	0.7755	0.6031	0.3651	0.2031	0.2235	0.5040	0.7920	0.9166	0.9568	(89)
MIT 2	18.0210	18.3050	18.8046	19.3727	19.7555	19.9181	19.9350	19.9391	19.8720	19.4422	18.6960	17.9866	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3348	18.6009	19.0705	19.6069	19.9741	20.1343	20.1536	20.1565	20.0861	19.6701	18.9657	18.3014	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1848	18.4509	18.9205	19.4569	19.8241	19.9843	20.0036	20.0065	19.9361	19.5201	18.8157	18.1514	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9323	0.9085	0.8576	0.7567	0.5963	0.3690	0.2097	0.2301	0.5037	0.7729	0.8954	0.9400	(94)
Useful gains	648.0862	702.2970	728.2164	709.7379	580.6720	364.9863	197.0559	205.3780	417.4608	574.2153	613.7720	618.0852	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1259.4265	1229.3309	1102.0656	906.2914	647.1345	373.8261	197.8770	206.5054	444.3604	746.9735	1020.0689	1241.1988	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	454.8372	354.1668	278.1438	141.5185	49.4481	0.0000	0.0000	0.0000	0.0000	128.5322	292.5338	463.5965	(98)
Space heating												2162.7768	(98)
Space heating per m2											(98) / (4) =	27.1093	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2389.8086	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	454.8372	354.1668	278.1438	141.5185	49.4481	0.0000	0.0000	0.0000	0.0000	128.5322	292.5338	463.5965	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	502.5825	391.3445	307.3412	156.3740	54.6388	0.0000	0.0000	0.0000	0.0000	142.0245	323.2417	512.2614	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6248	89.5473	89.3506	88.9244	88.1686	87.3000	87.3000	87.3000	87.3000	88.8177	89.3975	89.6553	(217)
Fuel for water heating, kWh/month													
	184.2836	161.7484	168.3098	148.9119	145.2123	128.1956	120.4190	135.8687	136.8056	154.7422	165.9255	178.8924	(219)
Water heating fuel used												1829.3149	(219)
Annual totals kWh/year													
Space heating fuel - main system												2389.8086	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4651.0361	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2389.8086	3.9200	93.6805	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1829.3149	3.9200	71.7091	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			326.6420	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2389.8086	0.2160	516.1987	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.3149	0.2160	395.1320	(264)
Space and water heating			911.3307	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1135.4933	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2389.8086	1.2200	2915.5665	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.3149	1.2200	2231.7642	(264)
Space and water heating			5147.3307	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6473.3025	(272)
Primary energy kWh/m2/year			81.1394	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (16.0%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (99.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 89
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£253	£216	£38
Space heating	£194	£194	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£326	-£11	£339
Total cost of uses	£327	-£11	£338
Delivered energy	58 kWh/m²	24 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	81 kWh/m²	-2 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                                  Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
              165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                     3.0000 (H1)
Zero-loss collector efficiency                                                                                                       0.7000 (H2)
Collector heat loss coefficient                                                                                                      1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                            0.0050 (H3a)
Collector effective heat loss coefficient                                                                                            1.8063 (H3b)
Collector performance ratio                                                                                                          2.5804 (H4)
Annual solar radiation per m2                                                                                                     1079.5246 (H5)
Overshading factor                                                                                                                   0.8000 (H6)
Solar energy available                                                                                                            1813.6014 (H7)
Adjustment factor for showers                                                                                                        1.0000 (H7a)
Solar-to-load ratio                                                                                                                  1.2449 (H8)
Utilisation factor                                                                                                                   0.5521 (H9)
Collector performance factor                                                                                                         0.8793 (H10)
Dedicated solar storage volume                                                                                                      75.0000 (H11)
Effective solar volume                                                                                                              75.0000 (H13)
Daily hot water demand                                                                                                              92.5935 (H14)
Volume ratio Veff/V                                                                                                                  0.8100 (H15)
Solar storage volume factor                                                                                                          0.9579 (H16)
Solar input                                                                                                                       -843.3953 (H17)
Solar input    -24.4568   -40.8113   -69.5064   -93.1523  -115.0818  -113.1437  -111.6485   -97.5478   -76.3995   -52.1719   -29.0093   -20.4662 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -843.3953 (63)
Output from w/h
              140.7071   104.0299    80.8795    39.2667    12.9499     0.0000     0.0000    21.0655    43.0318    85.2666   119.3239   139.9203 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =    786.4412 (64)
Heat gains from water heating, kWh/month
               53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
               72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
              553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data    Specific data        factor                W
                                                          W/m2      or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Southeast                                3.0000          36.7938           0.4600           0.0000           0.7700           39.0971 (77)
Southwest                                0.7200          36.7938           0.4600           0.0000           0.7700            9.3833 (79)
Northwest                                5.0600          11.2829           0.4600           0.0000           0.7700           20.2219 (81)
Southeast                                4.5100          36.7938           0.4600           0.0000           0.7700           58.7760 (77)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    127.4783   223.8596   324.1358   431.5246   510.6391   518.9529   495.3294   434.4709   361.0362   252.2230   153.9129   108.3034 (83)
Total gains    681.4708   773.4495   852.3453   926.6212   971.8621   949.8411   908.5021   855.9248   801.5595   726.0707   664.7774   647.1454 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            33.6763    33.7999    33.9220    34.5073    34.6191    35.1491    35.1491    35.2490    34.9430    34.6191    34.3937    34.1612
alpha           3.2451     3.2533     3.2615     3.3005     3.3079     3.3433     3.3433     3.3499     3.3295     3.3079     3.2929     3.2774
util living area
                0.9663     0.9485     0.9159     0.8484     0.7366     0.5800     0.4413     0.4820     0.6896     0.8741     0.9484     0.9709 (86)

MIT            19.3283    19.5617    19.9129    20.3492    20.6927    20.9021    20.9703    20.9599    20.8183    20.3763    19.7864    19.2930 (87)
Th 2           19.8848    19.8884    19.8920    19.9087    19.9118    19.9264    19.9264    19.9291    19.9207    19.9118    19.9055    19.8989 (88)
util rest of house
                0.9596     0.9385     0.8993     0.8182     0.6846     0.5007     0.3415     0.3806     0.6152     0.8423     0.9366     0.9651 (89)
MIT 2          17.6965    18.0326    18.5332    19.1474    19.5964    19.8496    19.9112    19.9069    19.7628    19.2009    18.3711    17.6547 (90)
Living area fraction                                                                                 fLA = Living area / (4) =       0.2066 (91)
MIT            18.0336    18.3485    18.8182    19.3957    19.8229    20.0670    20.1300    20.1244    19.9808    19.4437    18.6635    17.9931 (92)
Temperature adjustment                                                                                                              -0.1500
adjusted MIT   17.8836    18.1985    18.6682    19.2457    19.6729    19.9170    19.9800    19.9744    19.8308    19.2937    18.5135    17.8431 (93)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9182	0.8761	0.7966	0.6719	0.5000	0.3466	0.3851	0.6083	0.8202	0.9165	0.9497	(94)
Useful gains	642.5043	710.1888	746.7080	738.1416	652.9838	474.9301	314.9243	329.6037	487.6052	595.5046	609.2634	614.6050	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1348.3029	1315.1753	1199.0636	1002.1757	769.8336	505.6501	321.4354	338.9656	548.2193	839.4354	1109.2654	1334.9856	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	525.1142	406.5509	336.5526	190.1046	86.9363	0.0000	0.0000	0.0000	0.0000	181.4845	360.0015	535.9632	(98)
Space heating												2622.7077	(98)
Space heating per m2											(98) / (4) =	32.8743	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2898.0196	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	525.1142	406.5509	336.5526	190.1046	86.9363	0.0000	0.0000	0.0000	0.0000	181.4845	360.0015	535.9632	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	580.2367	449.2275	371.8813	210.0603	96.0622	0.0000	0.0000	0.0000	0.0000	200.5354	397.7917	592.2245	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8043	89.8291	89.8618	89.9356	90.0720	87.3000	87.3000	87.3000	87.3000	89.4519	89.6817	89.8184	(217)
Fuel for water heating, kWh/month	156.6818	115.8087	90.0043	43.6609	14.3772	0.0000	0.0000	24.1300	49.2919	95.3211	133.0528	155.7813	(219)
Water heating fuel used												878.1101	(219)
Annual totals kWh/year													
Space heating fuel - main system												2898.0196	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2530.8029	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2898.0196	3.4800	100.8511	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.1101	3.4800	30.5582	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			87.1507	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.2933	(257)
SAP value	95.9079	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2898.0196	0.2160	625.9722	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.1101	0.2160	189.6718	(264)
Space and water heating			815.6440	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			169.3194	(272)
CO2 emissions per m2			2.1200	(273)
EI value			98.1817	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3147 (H8)
Utilisation factor                                                                                                                  0.5326 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -859.2180 (H17)
Solar input    -26.4463   -39.7487   -66.9419   -92.5342  -111.4423  -117.2882  -114.4719  -102.2241   -79.7862   -54.2771   -32.1462   -21.9109 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -859.2180 (63)
Output from w/h
             138.7176   105.0925    83.4439    39.8847    16.5893     0.0000     0.0000    16.3893    39.6451    83.1613   116.1870   138.4756 (64)
                                                                                          Total per year (kWh/year) = Sum(64)m =    777.5864 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Southwest	0.7200	40.4699	0.4600	0.0000	0.7700	10.3208	(79)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

```
Solar gains    141.1347   223.4224   320.9017   442.7854   512.5197   558.2244   526.7372   471.0504   388.3102   269.1356   174.6459   118.7073 (83)
Total gains    695.1272   773.0124   849.1112   937.8820   973.7426   989.1125   939.9098   892.5043   828.8335   742.9833   685.5104   657.5493 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau        34.7290    34.9430    34.9430    35.2490    35.2490    35.6271    35.5359    35.7161    35.6271    35.4424    35.4424    35.1491
alpha       3.3153     3.3295     3.3295     3.3499     3.3499     3.3751     3.3691     3.3811     3.3751     3.3628     3.3628     3.3433
util living area
               0.9588     0.9409     0.9004     0.8124     0.6665     0.4534     0.3061     0.3300     0.5918     0.8336     0.9322     0.9641 (86)
MIT            19.5403    19.7373    20.0918    20.5065    20.8139    20.9648    20.9933    20.9915    20.9086    20.5457    20.0018    19.5106 (87)
Th 2           19.9148    19.9207    19.9207    19.9291    19.9291    19.9392    19.9368    19.9416    19.9392    19.9343    19.9343    19.9264 (88)
util rest of house
               0.9504     0.9292     0.8804     0.7755     0.6031     0.3651     0.2031     0.2235     0.5040     0.7920     0.9166     0.9568 (89)
MIT 2          18.0210    18.3050    18.8046    19.3727    19.7555    19.9181    19.9350    19.9391    19.8720    19.4422    18.6960    17.9866 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2066 (91)
MIT            18.3348    18.6009    19.0705    19.6069    19.9741    20.1343    20.1536    20.1565    20.0861    19.6701    18.9657    18.3014 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT   18.1848    18.4509    18.9205    19.4569    19.8241    19.9843    20.0036    20.0065    19.9361    19.5201    18.8157    18.1514 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9323	0.9085	0.8576	0.7567	0.5963	0.3690	0.2097	0.2301	0.5037	0.7729	0.8954	0.9400	(94)
Useful gains	648.0862	702.2970	728.2164	709.7379	580.6720	364.9863	197.0559	205.3780	417.4608	574.2153	613.7720	618.0852	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1259.4265	1229.3309	1102.0656	906.2914	647.1345	373.8261	197.8770	206.5054	444.3604	746.9735	1020.0689	1241.1988	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	454.8372	354.1668	278.1438	141.5185	49.4481	0.0000	0.0000	0.0000	0.0000	128.5322	292.5338	463.5965	(98)
Space heating												2162.7768	(98)
Space heating per m2											(98) / (4) =	27.1093	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2389.8086	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	454.8372	354.1668	278.1438	141.5185	49.4481	0.0000	0.0000	0.0000	0.0000	128.5322	292.5338	463.5965	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	502.5825	391.3445	307.3412	156.3740	54.6388	0.0000	0.0000	0.0000	0.0000	142.0245	323.2417	512.2614	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7313	89.7472	89.7409	89.7765	89.6743	87.3000	87.3000	87.3000	87.3000	89.2153	89.5667	89.7434	(217)
Fuel for water heating, kWh/month	154.5922	117.0983	92.9832	44.4267	18.4995	0.0000	0.0000	18.7735	45.4125	93.2142	129.7212	154.3016	(219)
Water heating fuel used												869.0230	(219)

Annual totals kWh/year		
Space heating fuel - main system	2389.8086	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	1916.5846	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2389.8086	3.9200	93.6805	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	869.0230	3.9200	34.0657	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-11.8989	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2389.8086	0.2160	516.1987	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	869.0230	0.2160	187.7090	(264)
Space and water heating			703.9076	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			7.2814 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2389.8086	1.2200	2915.5665	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	869.0230	1.2200	1060.2081	(264)
Space and water heating			3975.7746	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-144.9237	(272)
Primary energy kWh/m2/year			-1.8165	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	3.0000	119.9223	0.4600	0.0000	0.9000	148.9436
South West	0.7200	119.9223	0.4600	0.0000	0.9000	35.7465
North West	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						615.6668

	Jun	Jul	Aug	
Solar gains	652	616	551	(P4)
Internal gains	428	410	418	
Total summer gains	1080	1026	969	(P5)
Summer gain/loss ratio	3.29	3.13	2.95	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.24	21.97	21.70	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-339	**Issued on Date**	19/10/2022
Assessment Reference	Plot 339	**Prop Type Ref**	Badlesmere-As/Opp-MID
Property	Plot 339, 2 Bed, K, WC, Ut, B, En		

SAP Rating	85 B	**DER**	15.41	**TER**	17.02
Environmental	88 B	**% DER<TER**	9.48		
CO_2 Emissions (t/year)	1.02	**DFEE**	37.51	**TFEE**	44.58
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.86		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-Terrace House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.02 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.41 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)44.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)37.5 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South East: 7.51 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3778	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4817	0.4722	0.4628	0.4156	0.4061	0.3589	0.3589	0.3495	0.3778	0.4061	0.4250	0.4439	(22b)
Effective ac	0.6160	0.6115	0.6071	0.5863	0.5825	0.5644	0.5644	0.5611	0.5714	0.5825	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203	(36)
Total fabric heat loss	(33) + (36) =	43.6742	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.9232	41.6167	41.3162	39.9047	39.6406	38.4113	38.4113	38.1836	38.8848	39.6406	40.1748	40.7334	(38)
Heat transfer coeff	85.5975	85.2909	84.9904	83.5789	83.3149	82.0855	82.0855	81.8579	82.5591	83.3149	83.8491	84.4076	(39)
Average = Sum(39)m / 12 =												83.5777	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0729	1.0691	1.0653	1.0476	1.0443	1.0289	1.0289	1.0260	1.0348	1.0443	1.0510	1.0580	(40)
HLP (average)												1.0476	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.5374	372.3806	358.8122	336.9846	314.8455	293.5503	279.7572	285.7928	297.0501	319.0892	344.3715	363.3094	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	492.6324	580.2569	661.0790	741.4125	795.1340	782.3721	746.0370	693.6416	634.4068	553.6474	487.0453	463.5826	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.0965	38.2334	38.3686	39.0166	39.1402	39.7264	39.7264	39.8369	39.4986	39.1402	38.8909	38.6335	
alpha	3.5398	3.5489	3.5579	3.6011	3.6093	3.6484	3.6484	3.6558	3.6332	3.6093	3.5927	3.5756	
util living area													
	0.9848	0.9723	0.9463	0.8852	0.7728	0.6103	0.4658	0.5146	0.7401	0.9179	0.9742	0.9876	(86)
MIT	19.3175	19.5571	19.9167	20.3631	20.7121	20.9136	20.9753	20.9646	20.8197	20.3566	19.7614	19.2821	(87)
Th 2	20.0230	20.0262	20.0293	20.0438	20.0466	20.0593	20.0593	20.0617	20.0544	20.0466	20.0410	20.0353	(88)
util rest of house													
	0.9817	0.9668	0.9355	0.8620	0.7278	0.5381	0.3736	0.4205	0.6753	0.8962	0.9682	0.9851	(89)
MIT 2	17.7731	18.1215	18.6396	19.2757	19.7397	19.9877	20.0455	20.0403	19.8877	19.2815	18.4303	17.7296	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.0921	18.4181	18.9034	19.5003	19.9405	20.1790	20.2376	20.2313	20.0803	19.5036	18.7052	18.0503	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9421	18.2681	18.7534	19.3503	19.7905	20.0290	20.0876	20.0813	19.9303	19.3536	18.5552	17.9003	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9532	0.9171	0.8418	0.7143	0.5357	0.3765	0.4225	0.6657	0.8761	0.9550	0.9768	(94)
Useful gains	478.9395	553.0745	606.2443	624.1106	567.9797	419.0940	280.8574	293.0808	422.3364	485.0697	465.1487	452.8458	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1167.7292	1140.1758	1041.4235	873.4276	674.0629	445.6424	286.2774	301.3393	481.3410	729.3025	960.5118	1156.4068	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	512.4595	394.5321	323.7733	179.5082	78.9259	0.0000	0.0000	0.0000	0.0000	181.7092	356.6614	523.4494	(98)
Space heating												2551.0190	(98)
Space heating per m2											(98) / (4) =	31.9757	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2818.8056	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	512.4595	394.5321	323.7733	179.5082	78.9259	0.0000	0.0000	0.0000	0.0000	181.7092	356.6614	523.4494	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	566.2536	435.9470	357.7606	198.3516	87.2110	0.0000	0.0000	0.0000	0.0000	200.7836	394.1010	578.3971	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6986	89.6179	89.4600	89.1133	88.4933	87.3000	87.3000	87.3000	87.3000	89.0936	89.5360	89.7286	(217)
Fuel for water heating, kWh/month													
	184.1321	161.6209	168.1041	148.5961	144.6794	128.1956	120.4190	135.8687	136.8056	154.2629	165.6688	178.7462	(219)
Water heating fuel used												1827.0995	(219)
Annual totals kWh/year													
Space heating fuel - main system												2818.8056	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Total delivered energy for all uses												5081.6980	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2818.8056	0.2160	608.8620	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1827.0995	0.2160	394.6535	(264)
Space and water heating			1003.5155	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Total CO2, kg/year			1229.6920	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.4100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.4100	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		33.9063	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.9063	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3361	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4286	0.4202	0.4118	0.3698	0.3614	0.3193	0.3193	0.3109	0.3361	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5918	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5483	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
GF B&B J150 P/A=0.20			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.1800	5.7474			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.9136			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6082	(36)
Total fabric heat loss (33) + (36) =	43.5218	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.2787	40.0360	39.7981	38.6806	38.4716	37.4983	37.4983	37.3181	37.8732	38.4716	38.8945	39.3367	(38)
Heat transfer coeff	83.8005	83.5578	83.3199	82.2024	81.9933	81.0201	81.0201	80.8398	81.3950	81.9933	82.4163	82.8585	(39)
Average = Sum(39)m / 12 =												82.2014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0504	1.0474	1.0444	1.0304	1.0277	1.0155	1.0155	1.0133	1.0202	1.0277	1.0330	1.0386	(40)
HLP (average)												1.0304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.9163	384.4486	370.2580	347.8101	325.0467	303.1290	289.3430	296.0006	307.8855	330.5449	356.4452	375.6922	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	101.8955	179.3612	260.8037	348.9509	414.4055	421.7682	402.3184	351.9026	291.0802	202.3829	123.1027	86.5183	(83)
Total gains	488.8118	563.8098	631.0617	696.7611	739.4522	724.8972	691.6614	647.9032	598.9656	532.9278	479.5479	462.2106	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.1127	66.3048	66.4941	67.3980	67.5699	68.3816	68.3816	68.5340	68.0666	67.5699	67.2231	66.8644	
alpha	5.4075	5.4203	5.4329	5.4932	5.5047	5.5588	5.5588	5.5689	5.5378	5.5047	5.4815	5.4576	
util living area													
	0.9978	0.9948	0.9858	0.9530	0.8590	0.6797	0.5091	0.5625	0.8185	0.9704	0.9951	0.9984	(86)
MIT	19.9069	20.0590	20.2966	20.6021	20.8466	20.9689	20.9947	20.9911	20.9140	20.5960	20.1960	19.8819	(87)
Th 2	20.0415	20.0441	20.0465	20.0581	20.0603	20.0704	20.0704	20.0723	20.0665	20.0603	20.0559	20.0513	(88)
util rest of house													
	0.9971	0.9930	0.9808	0.9362	0.8125	0.5954	0.4049	0.4550	0.7464	0.9566	0.9931	0.9978	(89)
MIT 2	18.5809	18.8044	19.1504	19.5912	19.9109	20.0498	20.0684	20.0686	19.9984	19.5914	19.0138	18.5515	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.8548	19.0636	19.3872	19.8000	20.1042	20.2397	20.2598	20.2591	20.1875	19.7989	19.2580	18.8263	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8548	19.0636	19.3872	19.8000	20.1042	20.2397	20.2598	20.2591	20.1875	19.7989	19.2580	18.8263	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9905	0.9763	0.9306	0.8149	0.6115	0.4265	0.4772	0.7569	0.9516	0.9907	0.9968	(94)
Useful gains	486.7197	558.4596	616.0780	648.3956	602.5877	443.2781	294.9797	309.1862	453.3514	507.1221	475.1081	460.7233	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1219.7023	1183.4786	1073.7571	896.0061	689.0884	456.9267	296.5136	311.9716	495.4958	754.2493	1002.0179	1211.9150	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	545.3391	420.0128	340.5132	178.2796	64.3565	0.0000	0.0000	0.0000	0.0000	183.8626	379.3751	558.8866	(98)
Space heating												2670.6255	(98)
Space heating per m2											(98) / (4) =	33.4749	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2859.3421	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	545.3391	420.0128	340.5132	178.2796	64.3565	0.0000	0.0000	0.0000	0.0000	183.8626	379.3751	558.8866	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	583.8749	449.6925	364.5752	190.8775	68.9042	0.0000	0.0000	0.0000	0.0000	196.8551	406.1832	598.3797	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.4277	87.1467	86.5740	85.2679	82.9785	80.3000	80.3000	80.3000	80.3000	85.2262	86.8442	87.5282	(217)
Fuel for water heating, kWh/month													
	231.0524	203.4275	213.0530	191.8620	190.8811	173.7253	166.4421	185.5439	187.5930	201.2650	210.8436	225.3419	(219)
Water heating fuel used												2381.0309	(219)
Annual totals kWh/year													
Space heating fuel - main system												2859.3421	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Total delivered energy for all uses												5676.1659	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2859.3421	0.2160	617.6179	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2381.0309	0.2160	514.3027	(264)
Space and water heating			1131.9206	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Total CO2, kg/m2/year			1358.0971	(272)
Emissions per m2 for space and water heating			14.1880	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3471	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1880 * 1.00) + 2.3471 + 0.4879, rounded to 2 d.p.			17.0200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3366	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4291	0.4207	0.4123	0.3702	0.3618	0.3197	0.3197	0.3113	0.3366	0.3618	0.3786	0.3955	(22b)
Effective ac	0.5921	0.5885	0.5850	0.5685	0.5655	0.5511	0.5511	0.5485	0.5566	0.5655	0.5717	0.5782	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.2945	40.0512	39.8127	38.6924	38.4828	37.5071	37.5071	37.3264	37.8829	38.4828	38.9068	39.3501	(38)
Heat transfer coeff	83.9688	83.7255	83.4869	82.3667	82.1571	81.1813	81.1813	81.0006	81.5572	82.1571	82.5811	83.0244	(39)
Average = Sum(39)m / 12 =												82.3657	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0525	1.0495	1.0465	1.0324	1.0298	1.0176	1.0176	1.0153	1.0223	1.0298	1.0351	1.0407	(40)
HLP (average)												1.0324	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.4310	341.0521	329.0988	309.4643	288.7499	269.4586	257.3659	261.2197	271.6995	291.4691	314.1883	331.9756	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	460.5260	548.9285	631.3656	713.8922	769.0385	758.2804	723.6457	669.0685	609.0562	526.0273	456.8621	432.2488	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.8354	38.9483	39.0596	39.5908	39.6918	40.1689	40.1689	40.2585	39.9838	39.6918	39.4880	39.2772	
alpha	3.5890	3.5966	3.6040	3.6394	3.6461	3.6779	3.6779	3.6839	3.6656	3.6461	3.6325	3.6185	
util living area													
	0.9876	0.9762	0.9518	0.8930	0.7822	0.6204	0.4743	0.5264	0.7536	0.9268	0.9785	0.9900	(86)
MIT	19.3024	19.5437	19.9059	20.3529	20.7070	20.9112	20.9747	20.9630	20.8125	20.3384	19.7382	19.2619	(87)
Th 2	20.0398	20.0423	20.0448	20.0564	20.0586	20.0687	20.0687	20.0706	20.0648	20.0586	20.0542	20.0496	(88)
util rest of house													
	0.9851	0.9715	0.9420	0.8710	0.7383	0.5486	0.3817	0.4317	0.6901	0.9069	0.9734	0.9880	(89)
MIT 2	18.4846	18.7251	19.0827	19.5211	19.8441	20.0181	20.0589	20.0552	19.9453	19.5176	18.9288	18.4517	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.6535	18.8942	19.2527	19.6929	20.0224	20.2026	20.2481	20.2427	20.1244	19.6872	19.0960	18.6191	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6535	18.8942	19.2527	19.6929	20.0224	20.2026	20.2481	20.2427	20.1244	19.6872	19.0960	18.6191	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9802	0.9641	0.9320	0.8612	0.7365	0.5595	0.4001	0.4500	0.6946	0.8974	0.9667	0.9838	(94)
Useful gains	451.4084	529.2393	588.4086	614.7804	566.3634	424.2508	289.5111	301.0482	423.0509	472.0720	441.6416	425.2619	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1205.2465	1171.6707	1064.6842	888.9747	683.7419	454.8248	296.1573	311.2625	491.3357	746.5746	990.6444	1197.1368	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	560.8556	431.7139	354.3491	197.4199	87.3296	0.0000	0.0000	0.0000	0.0000	204.2299	395.2820	574.2749	(98)
Space heating												2805.4549	(98)
Space heating per m2											(98) / (4) =	35.1649	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	763.1044	600.7418	615.6048	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8716	0.9198	0.8991	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	665.1464	552.5709	553.5157	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	978.3362	935.9885	873.8535	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	225.4966	285.2627	238.3313	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												749.0906 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	56.3742	71.3157	59.5828	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												187.2727 (107)
Space cooling per m2												2.3474 (108)
Energy for space heating												35.1649 (99)
Energy for space cooling												2.3474 (108)
Total												37.5123 (109)
Dwelling Fabric Energy Efficiency (DFEE)												37.5 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3361	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4286	0.4202	0.4118	0.3698	0.3614	0.3193	0.3193	0.3109	0.3361	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5918	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5483	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
GF B&B J150 P/A=0.20			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.1800	5.7474			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.9136			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6082	(36)
Total fabric heat loss (33) + (36) =	43.5218	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.2787	40.0360	39.7981	38.6806	38.4716	37.4983	37.4983	37.3181	37.8732	38.4716	38.8945	39.3367	(38)
Heat transfer coeff	83.8005	83.5578	83.3199	82.2024	81.9933	81.0201	81.0201	80.8398	81.3950	81.9933	82.4163	82.8585	(39)
Average = Sum(39)m / 12 =												82.2014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0504	1.0474	1.0444	1.0304	1.0277	1.0155	1.0155	1.0133	1.0202	1.0277	1.0330	1.0386	(40)
HLP (average)												1.0304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.4296	18.1454	14.7568	11.1719	8.3511	7.0503	7.6181	9.9024	13.2909	16.8759	19.6966	20.9974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.4310	341.0521	329.0988	309.4643	288.7499	269.4586	257.3659	261.2197	271.6995	291.4691	314.1883	331.9756	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	101.8955	179.3612	260.8037	348.9509	414.4055	421.7682	402.3184	351.9026	291.0802	202.3829	123.1027	86.5183	(83)
Total gains	444.3264	520.4133	589.9024	658.4152	703.1554	691.2268	659.6843	613.1223	562.7797	493.8520	437.2910	418.4939	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.1127	66.3048	66.4941	67.3980	67.5699	68.3816	68.3816	68.5340	68.0666	67.5699	67.2231	66.8644	
alpha	5.4075	5.4203	5.4329	5.4932	5.5047	5.5588	5.5588	5.5689	5.5378	5.5047	5.4815	5.4576	
util living area													
	0.9986	0.9964	0.9895	0.9624	0.8784	0.7055	0.5321	0.5912	0.8462	0.9786	0.9968	0.9990	(86)
MIT	19.8541	20.0082	20.2505	20.5655	20.8256	20.9627	20.9934	20.9887	20.8970	20.5552	20.1464	19.8297	(87)
Th 2	20.0415	20.0441	20.0465	20.0581	20.0603	20.0704	20.0704	20.0723	20.0665	20.0603	20.0559	20.0513	(88)
util rest of house													
	0.9982	0.9952	0.9857	0.9483	0.8353	0.6206	0.4241	0.4798	0.7784	0.9680	0.9956	0.9987	(89)
MIT 2	18.9917	19.1474	19.3897	19.7057	19.9421	20.0532	20.0687	20.0690	20.0091	19.7020	19.2952	18.9753	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.1699	19.3252	19.5675	19.8833	20.1246	20.2411	20.2597	20.2590	20.1925	19.8782	19.4710	19.1518	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1699	19.3252	19.5675	19.8833	20.1246	20.2411	20.2597	20.2590	20.1925	19.8782	19.4710	19.1518	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9940	0.9833	0.9451	0.8386	0.6371	0.4466	0.5029	0.7888	0.9654	0.9945	0.9982	(94)
Useful gains	443.2425	517.2819	580.0327	622.3009	589.6941	440.4097	294.5846	308.3583	443.9248	476.7625	434.8699	417.7515	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1246.1009	1205.3377	1088.7843	902.8560	690.7612	457.0433	296.5102	311.9584	495.9028	760.7508	1019.5743	1238.8848	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	597.3267	462.3735	378.5112	201.9997	75.1939	0.0000	0.0000	0.0000	0.0000	211.2873	420.9871	610.9232	(98)
Space heating												2958.6026	(98)
Space heating per m2											(98) / (4) =	37.0845	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	761.5886	599.5485	614.3827	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9087	0.9553	0.9377	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	692.0215	572.7263	576.0989	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	899.9618	861.2284	808.4618	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	149.7170	214.6455	172.8780	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												537.2406	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Intermittency factor (Table 10b)
          0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
          0.0000    0.0000    0.0000    0.0000    0.0000   37.4293   53.6614   43.2195    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                            134.3101 (107)
Space cooling per m2                                                                                                       1.6835 (108)
Energy for space heating                                                                                                  37.0845 (99)
Energy for space cooling                                                                                                   1.6835 (108)
Total                                                                                                                     38.7680 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                       44.6 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3778	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3967	0.3778	0.3778	0.3495	0.3495	0.3117	0.3211	0.3022	0.3117	0.3306	0.3306	0.3589	(22b)
Effective ac	0.5787	0.5714	0.5714	0.5611	0.5611	0.5486	0.5516	0.5457	0.5486	0.5546	0.5546	0.5644	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3826	38.8848	38.8848	38.1836	38.1836	37.3337	37.5371	37.1364	37.3337	37.7465	37.7465	38.4113	(38)
Heat transfer coeff	83.0569	82.5591	82.5591	81.8579	81.8579	81.0080	81.2113	80.8107	81.0080	81.4208	81.4208	82.0855	(39)
Average = Sum(39)m / 12 =												81.7380	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0411	1.0348	1.0348	1.0260	1.0260	1.0154	1.0179	1.0129	1.0154	1.0206	1.0206	1.0289	(40)
HLP (average)												1.0245	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

Solar gains	130.8139	207.6075	299.4923	415.3133	482.3799	526.1195	496.1541	442.5203	363.1421	250.4682	161.9836	109.9581	(83)
Total gains	685.3557	757.6853	828.0986	910.7102	943.8274	957.1973	909.5316	864.2404	804.0228	724.7696	673.3777	649.3646	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.2618	39.4986	39.4986	39.8369	39.8369	40.2549	40.1540	40.3531	40.2549	40.0508	40.0508	39.7264	
alpha	3.6175	3.6332	3.6332	3.6558	3.6558	3.6837	3.6769	3.6902	3.6837	3.6701	3.6701	3.6484	
util living area													
	0.9529	0.9322	0.8851	0.7843	0.6256	0.4127	0.2750	0.2968	0.5478	0.8067	0.9213	0.9590	(86)
MIT	19.8001	19.9825	20.2981	20.6492	20.8837	20.9819	20.9971	20.9962	20.9468	20.6734	20.2080	19.7693	(87)
Th 2	20.0492	20.0544	20.0544	20.0617	20.0617	20.0705	20.0684	20.0726	20.0705	20.0662	20.0662	20.0593	(88)
util rest of house													
	0.9442	0.9202	0.8648	0.7483	0.5684	0.3400	0.1932	0.2119	0.4719	0.7657	0.9051	0.9514	(89)
MIT 2	18.4841	18.7460	19.1878	19.6643	19.9518	20.0591	20.0675	20.0713	20.0304	19.7105	19.0787	18.4476	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.7560	19.0014	19.4172	19.8677	20.1443	20.2497	20.2595	20.2624	20.2197	19.9094	19.3120	18.7206	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6060	18.8514	19.2672	19.7177	19.9943	20.0997	20.1095	20.1124	20.0697	19.7594	19.1620	18.5706	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9010	0.8448	0.7337	0.5641	0.3423	0.1969	0.2156	0.4718	0.7504	0.8856	0.9354	(94)
Useful gains	635.3603	682.6940	699.5370	668.1480	532.3996	327.6880	179.0698	186.3485	379.3605	543.8853	596.3422	607.3905	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1121.7623	1094.0267	979.7437	803.6590	572.5401	332.1123	179.4386	186.8634	394.4849	664.3481	908.8179	1105.7417	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	361.8831	276.4156	208.4738	97.5679	29.8646	0.0000	0.0000	0.0000	0.0000	89.6244	224.9825	370.7733	(98)
Space heating												1659.5851	(98)
RHI space heating demand												1660	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b)	= 101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c)	= 104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		= 0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		= 0.3778	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4817	0.4722	0.4628	0.4156	0.4061	0.3589	0.3589	0.3495	0.3778	0.4061	0.4250	0.4439	(22b)
Effective ac	0.6160	0.6115	0.6071	0.5863	0.5825	0.5644	0.5644	0.5611	0.5714	0.5825	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.9232	41.6167	41.3162	39.9047	39.6406	38.4113	38.4113	38.1836	38.8848	39.6406	40.1748	40.7334	(38)
Heat transfer coeff	85.5975	85.2909	84.9904	83.5789	83.3149	82.0855	82.0855	81.8579	82.5591	83.3149	83.8491	84.4076	(39)
Average = Sum(39)m / 12 =												83.5777	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0729	1.0691	1.0653	1.0476	1.0443	1.0289	1.0289	1.0260	1.0348	1.0443	1.0510	1.0580	(40)
HLP (average)												1.0476	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	672.6367	757.9542	830.8731	899.8248	941.7360	919.8995	879.6573	829.5690	778.2374	708.8596	654.0679	639.6798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.0965	38.2334	38.3686	39.0166	39.1402	39.7264	39.7264	39.8369	39.4986	39.1402	38.8909	38.6335	
alpha	3.5398	3.5489	3.5579	3.6011	3.6093	3.6484	3.6484	3.6558	3.6332	3.6093	3.5927	3.5756	
util living area													
	0.9620	0.9417	0.9039	0.8259	0.7012	0.5368	0.4010	0.4397	0.6494	0.8540	0.9408	0.9673	(86)
MIT	19.6061	19.8239	20.1407	20.5189	20.7944	20.9432	20.9848	20.9788	20.8842	20.5311	20.0138	19.5700	(87)
Th 2	20.0230	20.0262	20.0293	20.0438	20.0466	20.0593	20.0593	20.0617	20.0544	20.0466	20.0410	20.0353	(88)
util rest of house													
	0.9551	0.9314	0.8870	0.7959	0.6525	0.4684	0.3193	0.3557	0.5819	0.8220	0.9286	0.9613	(89)
MIT 2	18.1875	18.5002	18.9496	19.4784	19.8339	20.0137	20.0511	20.0493	19.9523	19.5091	18.7868	18.1442	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.4805	18.7737	19.1956	19.6933	20.0323	20.2057	20.2440	20.2413	20.1448	19.7202	19.0403	18.4387	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3305	18.6237	19.0456	19.5433	19.8823	20.0557	20.0940	20.0913	19.9948	19.5702	18.8903	18.2887	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9391	0.9125	0.8662	0.7781	0.6435	0.4681	0.3223	0.3584	0.5773	0.8033	0.9097	0.9465	(94)
Useful gains	631.6691	691.6235	719.6889	700.1969	605.9932	430.5995	283.5464	297.3333	449.3009	569.3990	595.0356	605.4784	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1200.9785	1170.5039	1066.2575	889.5579	681.7053	447.8325	286.8032	302.1643	486.6683	747.3528	988.6019	1189.1963	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	423.5662	321.8076	257.8471	136.3399	56.3298	0.0000	0.0000	0.0000	0.0000	132.3976	283.3677	434.2862	(98)
Space heating												2045.9421	(98)
Space heating per m2											(98) / (4) =	25.6448	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2260.7095	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	423.5662	321.8076	257.8471	136.3399	56.3298	0.0000	0.0000	0.0000	0.0000	132.3976	283.3677	434.2862	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	468.0290	355.5885	284.9139	150.6518	62.2429	0.0000	0.0000	0.0000	0.0000	146.2957	313.1135	479.8742	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5788	89.4819	89.2942	88.8945	88.2535	87.3000	87.3000	87.3000	87.3000	88.8413	89.3743	89.6141	(217)
Fuel for water heating, kWh/month	184.3783	161.8664	168.4161	148.9619	145.0726	128.1956	120.4190	135.8687	136.8056	154.7010	165.9684	178.9747	(219)
Water heating fuel used												1829.6282	(219)
Annual totals kWh/year													
Space heating fuel - main system												2260.7095	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Total delivered energy for all uses												4526.1307	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2260.7095	3.4800	78.6727	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1829.6282	3.4800	63.6711	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	360.7929	13.1900	47.5886	(250)
Additional standing charges			120.0000	(251)
Total energy cost			319.8248	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0765	(257)
SAP value		84.9827	
SAP rating (Section 12)		85	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2260.7095	0.2160	488.3133	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.6282	0.2160	395.1997	(264)
Space and water heating			883.5130	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Total kg/year			1109.6895	(272)
CO2 emissions per m2			13.9100	(273)
EI value			88.0832	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8854 = 3.930, stars = 4
Water heating environmental impact	0.216 / 0.8854 = 0.2439, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3778	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3967	0.3778	0.3778	0.3495	0.3495	0.3117	0.3211	0.3022	0.3117	0.3306	0.3306	0.3589	(22b)
Effective ac	0.5787	0.5714	0.5714	0.5611	0.5611	0.5486	0.5516	0.5457	0.5486	0.5546	0.5546	0.5644	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3826	38.8848	38.8848	38.1836	38.1836	37.3337	37.5371	37.1364	37.3337	37.7465	37.7465	38.4113	(38)
Heat transfer coeff	83.0569	82.5591	82.5591	81.8579	81.8579	81.0080	81.2113	80.8107	81.0080	81.4208	81.4208	82.0855	(39)
Average = Sum(39)m / 12 =												81.7380	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0411	1.0348	1.0348	1.0260	1.0260	1.0154	1.0179	1.0129	1.0154	1.0206	1.0206	1.0289	(40)
HLP (average)												1.0245	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

Solar gains	130.8139	207.6075	299.4923	415.3133	482.3799	526.1195	496.1541	442.5203	363.1421	250.4682	161.9836	109.9581	(83)
Total gains	685.3557	757.6853	828.0986	910.7102	943.8274	957.1973	909.5316	864.2404	804.0228	724.7696	673.3777	649.3646	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.2618	39.4986	39.4986	39.8369	39.8369	40.2549	40.1540	40.3531	40.2549	40.0508	40.0508	39.7264	
alpha	3.6175	3.6332	3.6332	3.6558	3.6558	3.6837	3.6769	3.6902	3.6837	3.6701	3.6701	3.6484	
util living area													
	0.9529	0.9322	0.8851	0.7843	0.6256	0.4127	0.2750	0.2968	0.5478	0.8067	0.9213	0.9590	(86)
MIT	19.8001	19.9825	20.2981	20.6492	20.8837	20.9819	20.9971	20.9962	20.9468	20.6734	20.2080	19.7693	(87)
Th 2	20.0492	20.0544	20.0544	20.0617	20.0617	20.0705	20.0684	20.0726	20.0705	20.0662	20.0662	20.0593	(88)
util rest of house													
	0.9442	0.9202	0.8648	0.7483	0.5684	0.3400	0.1932	0.2119	0.4719	0.7657	0.9051	0.9514	(89)
MIT 2	18.4841	18.7460	19.1878	19.6643	19.9518	20.0591	20.0675	20.0713	20.0304	19.7105	19.0787	18.4476	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.7560	19.0014	19.4172	19.8677	20.1443	20.2497	20.2595	20.2624	20.2197	19.9094	19.3120	18.7206	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6060	18.8514	19.2672	19.7177	19.9943	20.0997	20.1095	20.1124	20.0697	19.7594	19.1620	18.5706	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9010	0.8448	0.7337	0.5641	0.3423	0.1969	0.2156	0.4718	0.7504	0.8856	0.9354	(94)
Useful gains	635.3603	682.6940	699.5370	668.1480	532.3996	327.6880	179.0698	186.3485	379.3605	543.8853	596.3422	607.3905	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1121.7623	1094.0267	979.7437	803.6590	572.5401	332.1123	179.4386	186.8634	394.4849	664.3481	908.8179	1105.7417	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	361.8831	276.4156	208.4738	97.5679	29.8646	0.0000	0.0000	0.0000	0.0000	89.6244	224.9825	370.7733	(98)
Space heating												1659.5851	(98)
Space heating per m2											(98) / (4) =	20.8020	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1833.7957	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	361.8831	276.4156	208.4738	97.5679	29.8646	0.0000	0.0000	0.0000	0.0000	89.6244	224.9825	370.7733	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	399.8708	305.4316	230.3577	107.8098	32.9995	0.0000	0.0000	0.0000	0.0000	99.0324	248.5995	409.6942	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.4722	89.3736	89.1309	88.6295	87.8878	87.3000	87.3000	87.3000	87.3000	88.5357	89.2008	89.5093	(217)
Fuel for water heating, kWh/month													
	184.5979	162.0627	168.7248	149.4073	145.6762	128.1956	120.4190	135.8687	136.8056	155.2351	166.2913	179.1842	(219)
Water heating fuel used												1832.4684	(219)
Annual totals kWh/year													
Space heating fuel - main system												1833.7957	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Total delivered energy for all uses												4102.0570	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1833.7957	3.9200	71.8848	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1832.4684	3.9200	71.8328	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	360.7929	16.9600	61.1905	(250)
Additional standing charges			88.0000	(251)
Total energy cost			305.6280	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1833.7957	0.2160	396.0999	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.4684	0.2160	395.8132	(264)
Space and water heating			791.9130	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Total kg/year			1018.0896	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1833.7957	1.2200	2237.2307	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.4684	1.2200	2235.6114	(264)
Space and water heating			4472.8421	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	360.7929	3.0700	1107.6343	(268)
Primary energy kWh/year			5810.7265	(272)
Primary energy kWh/m2/year			72.8344	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 85
Current environmental impact rating:	B 88

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (17.9%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (113.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.28 kg/m²	B 86	B 90
Solar photovoltaic panels	£309	11.87 kg/m²	A 97	A 100
Total Savings	£339	14.15 kg/m²		

Potential energy efficiency rating:	A 97
Potential environmental impact rating:	A 100

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£74	£82	-£8
Mains gas	£232	£194	£38
Space heating	£173	£173	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£306	-£33	£339
Total cost of uses	£306	-£32	£338
Delivered energy	51 kWh/m²	17 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.0 tonnes	-0.1 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	-1 kg/m²	14 kg/m²
Primary energy	73 kWh/m²	-10 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3778	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4817	0.4722	0.4628	0.4156	0.4061	0.3589	0.3589	0.3495	0.3778	0.4061	0.4250	0.4439	(22b)
Effective ac	0.6160	0.6115	0.6071	0.5863	0.5825	0.5644	0.5644	0.5611	0.5714	0.5825	0.5903	0.5985	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203 (36)
Total fabric heat loss	(33) + (36) =	43.6742 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.9232	41.6167	41.3162	39.9047	39.6406	38.4113	38.4113	38.1836	38.8848	39.6406	40.1748	40.7334	(38)
Heat transfer coeff	85.5975	85.2909	84.9904	83.5789	83.3149	82.0855	82.0855	81.8579	82.5591	83.3149	83.8491	84.4076	(39)
Average = Sum(39)m / 12 =												83.5777	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0729	1.0691	1.0653	1.0476	1.0443	1.0289	1.0289	1.0260	1.0348	1.0443	1.0510	1.0580	(40)
HLP (average)												1.0476	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.0740	45.3635	36.8920	27.9296	20.8777	17.6259	19.0454	24.7559	33.2273	42.1897	49.2416	52.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	554.5417	550.0778	528.6063	495.3969	461.4475	431.0777	413.3774	421.7201	440.8806	474.3014	511.3941	539.4066	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	118.0950	207.8764	302.2668	404.4279	480.2886	488.8218	466.2798	407.8488	337.3567	234.5582	142.6738	100.2732	(83)
Total gains	672.6367	757.9542	830.8731	899.8248	941.7360	919.8995	879.6573	829.5690	778.2374	708.8596	654.0679	639.6798	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.0965	38.2334	38.3686	39.0166	39.1402	39.7264	39.7264	39.8369	39.4986	39.1402	38.8909	38.6335	
alpha	3.5398	3.5489	3.5579	3.6011	3.6093	3.6484	3.6484	3.6558	3.6332	3.6093	3.5927	3.5756	
util living area													
	0.9620	0.9417	0.9039	0.8259	0.7012	0.5368	0.4010	0.4397	0.6494	0.8540	0.9408	0.9673	(86)
MIT	19.6061	19.8239	20.1407	20.5189	20.7944	20.9432	20.9848	20.9788	20.8842	20.5311	20.0138	19.5700	(87)
Th 2	20.0230	20.0262	20.0293	20.0438	20.0466	20.0593	20.0593	20.0617	20.0544	20.0466	20.0410	20.0353	(88)
util rest of house													
	0.9551	0.9314	0.8870	0.7959	0.6525	0.4684	0.3193	0.3557	0.5819	0.8220	0.9286	0.9613	(89)
MIT 2	18.1875	18.5002	18.9496	19.4784	19.8339	20.0137	20.0511	20.0493	19.9523	19.5091	18.7868	18.1442	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.4805	18.7737	19.1956	19.6933	20.0323	20.2057	20.2440	20.2413	20.1448	19.7202	19.0403	18.4387	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3305	18.6237	19.0456	19.5433	19.8823	20.0557	20.0940	20.0913	19.9948	19.5702	18.8903	18.2887	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9391	0.9125	0.8662	0.7781	0.6435	0.4681	0.3223	0.3584	0.5773	0.8033	0.9097	0.9465	(94)
Useful gains	631.6691	691.6235	719.6889	700.1969	605.9932	430.5995	283.5464	297.3333	449.3009	569.3990	595.0356	605.4784	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1200.9785	1170.5039	1066.2575	889.5579	681.7053	447.8325	286.8032	302.1643	486.6683	747.3528	988.6019	1189.1963	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	423.5662	321.8076	257.8471	136.3399	56.3298	0.0000	0.0000	0.0000	0.0000	132.3976	283.3677	434.2862	(98)

Space heating 2045.9421 (98)
Space heating per m2 (98) / (4) = 25.6448 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2260.7095 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	423.5662	321.8076	257.8471	136.3399	56.3298	0.0000	0.0000	0.0000	0.0000	132.3976	283.3677	434.2862	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	468.0290	355.5885	284.9139	150.6518	62.2429	0.0000	0.0000	0.0000	0.0000	146.2957	313.1135	479.8742	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6803	89.6968	89.7148	89.7643	89.8841	87.3000	87.3000	87.3000	87.3000	89.2189	89.5276	89.6988	(217)
Fuel for water heating, kWh/month	156.8986	115.9795	90.1518	43.7443	14.4073	0.0000	0.0000	24.1300	49.2919	95.5701	133.2817	155.9891	(219)

Water heating fuel used 879.4442 (219)
Annual totals kWh/year
Space heating fuel - main system 2260.7095 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 360.7929 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 1898.7073 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2260.7095	3.4800	78.6727	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	879.4442	3.4800	30.6047	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	360.7929	13.1900	47.5886	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			65.5306	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.2206 (257)
SAP value 96.9230
SAP rating (Section 12) 97 (258)
SAP band A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2260.7095	0.2160	488.3133	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	879.4442	0.2160	189.9599	(264)
Space and water heating			678.2732	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			33.9625	(272)
CO2 emissions per m2			0.4300	(273)
EI value			99.6353	
EI rating			100	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3778	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3967	0.3778	0.3778	0.3495	0.3495	0.3117	0.3211	0.3022	0.3117	0.3306	0.3306	0.3589	(22b)
Effective ac	0.5787	0.5714	0.5714	0.5611	0.5611	0.5486	0.5516	0.5457	0.5486	0.5546	0.5546	0.5644	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.0600	1.2357	9.9601			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.20			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	46.6300	14.7000	31.9300	0.2500	7.9825	52.3000	1669.9390	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			126.4100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4540			(33)
E-WM-30			91.5000	0.0000	0.0000	45.0000	4117.5000	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11739.4690	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2203	(36)
Total fabric heat loss	(33) + (36) =	43.6742	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3826	38.8848	38.8848	38.1836	38.1836	37.3337	37.5371	37.1364	37.3337	37.7465	37.7465	38.4113	(38)
Heat transfer coeff	83.0569	82.5591	82.5591	81.8579	81.8579	81.0080	81.2113	80.8107	81.0080	81.4208	81.4208	82.0855	(39)
Average = Sum(39)m / 12 =												81.7380	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0411	1.0348	1.0348	1.0260	1.0260	1.0154	1.0179	1.0129	1.0154	1.0206	1.0206	1.0289	(40)
HLP (average)												1.0245	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3147 (H8)
Utilisation factor                                                                                                                  0.5326 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -859.2180 (H17)
Solar input    -26.4463   -39.7487   -66.9419   -92.5342  -111.4423  -117.2882  -114.4719  -102.2241   -79.7862   -54.2771   -32.1462   -21.9109 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -859.2180 (63)
Output from w/h
             138.7176   105.0925    83.4439    39.8847    16.5893     0.0000     0.0000    16.3893    39.6451    83.1613   116.1870   138.4756 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =    777.5864 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              51.0740    45.3635    36.8920    27.9296    20.8777    17.6259    19.0454    24.7559    33.2273    42.1897    49.2416    52.4935 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             554.5417   550.0778   528.6063   495.3969   461.4475   431.0777   413.3774   421.7201   440.8806   474.3014   511.3941   539.4066 (73)


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6. Solar gains
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[Jan]                                    Area        Solar flux              g              FF          Access          Gains
                                          m2          Table 6a     Specific data  Specific data      factor               W
                                                         W/m2     or Table 6b    or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------------------
Southeast                                3.0000          40.4699          0.4600          0.0000          0.7700          43.0033 (77)
Northwest                                5.0600          12.9236          0.4600          0.0000          0.7700          23.1623 (81)
Southeast                                4.5100          40.4699          0.4600          0.0000          0.7700          64.6483 (77)
-------------------------------------------------------------------------------------------------------------

Solar gains    130.8139   207.6075   299.4923   415.3133   482.3799   526.1195   496.1541   442.5203   363.1421   250.4682   161.9836   109.9581 (83)
Total gains    685.3557   757.6853   828.0986   910.7102   943.8274   957.1973   909.5316   864.2404   804.0228   724.7696   673.3777   649.3646 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          39.2618    39.4986    39.4986    39.8369    39.8369    40.2549    40.1540    40.3531    40.2549    40.0508    40.0508    39.7264
alpha         3.6175     3.6332     3.6332     3.6558     3.6558     3.6837     3.6769     3.6902     3.6837     3.6701     3.6701     3.6484
util living area
               0.9529     0.9322     0.8851     0.7843     0.6256     0.4127     0.2750     0.2968     0.5478     0.8067     0.9213     0.9590 (86)

MIT           19.8001    19.9825    20.2981    20.6492    20.8837    20.9819    20.9971    20.9962    20.9468    20.6734    20.2080    19.7693 (87)
Th 2          20.0492    20.0544    20.0544    20.0617    20.0617    20.0705    20.0684    20.0726    20.0705    20.0662    20.0662    20.0593 (88)
util rest of house
               0.9442     0.9202     0.8648     0.7483     0.5684     0.3400     0.1932     0.2119     0.4719     0.7657     0.9051     0.9514 (89)
MIT 2         18.4841    18.7460    19.1878    19.6643    19.9518    20.0591    20.0675    20.0713    20.0304    19.7105    19.0787    18.4476 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.7560    19.0014    19.4172    19.8677    20.1443    20.2497    20.2595    20.2624    20.2197    19.9094    19.3120    18.7206 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.6060    18.8514    19.2672    19.7177    19.9943    20.0997    20.1095    20.1124    20.0697    19.7594    19.1620    18.5706 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9010	0.8448	0.7337	0.5641	0.3423	0.1969	0.2156	0.4718	0.7504	0.8856	0.9354	(94)
Useful gains	635.3603	682.6940	699.5370	668.1480	532.3996	327.6880	179.0698	186.3485	379.3605	543.8853	596.3422	607.3905	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1121.7623	1094.0267	979.7437	803.6590	572.5401	332.1123	179.4386	186.8634	394.4849	664.3481	908.8179	1105.7417	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	361.8831	276.4156	208.4738	97.5679	29.8646	0.0000	0.0000	0.0000	0.0000	89.6244	224.9825	370.7733	(98)
Space heating												1659.5851	(98)
Space heating per m2											(98) / (4) =	20.8020	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1833.7957	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	361.8831	276.4156	208.4738	97.5679	29.8646	0.0000	0.0000	0.0000	0.0000	89.6244	224.9825	370.7733	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	399.8708	305.4316	230.3577	107.8098	32.9995	0.0000	0.0000	0.0000	0.0000	99.0324	248.5995	409.6942	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5900	89.5953	89.5616	89.5475	89.3307	87.3000	87.3000	87.3000	87.3000	88.9311	89.3842	89.6069	(217)
Fuel for water heating, kWh/month	154.8360	117.2968	93.1693	44.5403	18.5707	0.0000	0.0000	18.7735	45.4125	93.5121	129.9861	154.5368	(219)
Water heating fuel used												870.6342	(219)
Annual totals kWh/year													
Space heating fuel - main system												1833.7957	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												360.7929	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =											-1824.1596	-1824.1596	(233)
Total delivered energy for all uses												1366.0631	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1833.7957	3.9200	71.8848	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	870.6342	3.9200	34.1289	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	360.7929	16.9600	61.1905	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-32.9733	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1833.7957	0.2160	396.0999	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	870.6342	0.2160	188.0570	(264)
Space and water heating			584.1568	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	360.7929	0.5190	187.2515	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)

Total kg/year -110.4555 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1833.7957	1.2200	2237.2307	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	870.6342	1.2200	1062.1737	(264)
Space and water heating			3299.4044	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	360.7929	3.0700	1107.6343	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-809.3813	(272)
Primary energy kWh/m2/year			-10.1452	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		272.23 (P1)
Transmission heat loss coefficient		43.67 (37)
Summer heat loss coefficient		315.90 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	3.0000	119.9223	0.4600	0.0000	0.9000	148.9436
North West	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						579.9204

	Jun	Jul	Aug	
Solar gains	615	580	517	(P4)
Internal gains	428	410	419	
Total summer gains	1043	990	936	(P5)
Summer gain/loss ratio	3.30	3.13	2.96	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.27	22.00	21.73	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-340	**Issued on Date**	19/10/2022
Assessment Reference	Plot 340	**Prop Type Ref**	Badlesmere-Opp-END
Property	Plot 340, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.21	**TER**	18.58
Environmental	87 B	**% DER<TER**	7.39		
CO_2 Emissions (t/year)	1.14	**DFEE**	45.82	**TFEE**	52.95
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.46		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

End-Terrace House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.21 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.8 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 0.72 m², No overhang
Windows facing South East: 7.51 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	495.2901	585.9189	671.4729	758.6227	818.3397	807.1316	769.1881	712.0567	647.1223	560.6237	490.4540	465.7066	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9860	0.9752	0.9530	0.9008	0.8022	0.6519	0.5091	0.5605	0.7766	0.9301	0.9771	0.9885	(86)
MIT	19.0436	19.2900	19.6769	20.1759	20.5923	20.8602	20.9545	20.9370	20.7333	20.1851	19.5316	19.0107	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9830	0.9699	0.9425	0.8780	0.7556	0.5708	0.3986	0.4494	0.7083	0.9092	0.9712	0.9860	(89)
MIT 2	17.2870	17.6459	18.2051	18.9199	19.4802	19.8126	19.9021	19.8926	19.6765	18.9491	18.0102	17.2476	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6499	17.9855	18.5091	19.1794	19.7099	20.0290	20.1195	20.1083	19.8948	19.2045	18.3245	17.6118	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4999	17.8355	18.3591	19.0294	19.5599	19.8790	19.9695	19.9583	19.7448	19.0545	18.1745	17.4618	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9731	0.9557	0.9229	0.8550	0.7381	0.5669	0.4033	0.4526	0.6952	0.8873	0.9576	0.9774	(94)
Useful gains	481.9646	559.9467	619.7107	648.6285	604.0505	457.5857	310.2077	322.3009	449.9111	497.4395	469.6772	455.1897	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1310.2163	1279.2793	1168.6054	981.2241	758.9281	502.0370	320.4437	337.4370	539.9932	816.3321	1076.3178	1297.6693	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	616.2193	483.3915	408.3777	239.4688	115.2289	0.0000	0.0000	0.0000	0.0000	237.2561	436.7812	626.8048	(98)
Space heating												3163.5283	(98)
Space heating per m2											(98) / (4) =	39.6532	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3495.6114	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	616.2193	483.3915	408.3777	239.4688	115.2289	0.0000	0.0000	0.0000	0.0000	237.2561	436.7812	626.8048	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	680.9053	534.1343	451.2460	264.6064	127.3248	0.0000	0.0000	0.0000	0.0000	262.1615	482.6312	692.6020	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8042	89.7416	89.6159	89.3340	88.7871	87.3000	87.3000	87.3000	87.3000	89.2994	89.6668	89.8291	(217)
Fuel for water heating, kWh/month													
	183.9156	161.3981	167.8116	148.2290	144.2007	128.1956	120.4190	135.8687	136.8056	153.9075	165.4272	178.5462	(219)
Water heating fuel used												1824.7247	(219)
Annual totals kWh/year													
Space heating fuel - main system												3495.6114	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5752.2488	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3495.6114	0.2160	755.0521	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.7247	0.2160	394.1405	(264)
Space and water heating			1149.1926	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1373.3553	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.2100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.2100	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.7063	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.7063	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	104.3782	184.4148	269.9087	363.9040	434.5054	443.1968	422.3644	367.8835	302.1748	208.5588	126.2266	88.5459	(83)
Total gains	491.0748	568.6683	640.0081	711.5940	759.4623	746.2500	711.6255	663.7776	609.9173	538.9222	482.4599	464.0122	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9978	0.9950	0.9871	0.9596	0.8805	0.7193	0.5507	0.6074	0.8494	0.9749	0.9953	0.9983	(86)
MIT	19.7243	19.8841	20.1421	20.4836	20.7747	20.9434	20.9880	20.9809	20.8641	20.4866	20.0459	19.7005	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9970	0.9933	0.9824	0.9441	0.8353	0.6274	0.4284	0.4829	0.7776	0.9623	0.9934	0.9977	(89)
MIT 2	18.2350	18.4700	18.8465	19.3420	19.7301	19.9262	19.9596	19.9583	19.8497	19.3556	18.7166	18.2082	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.5426	18.7621	19.1141	19.5778	19.9458	20.1363	20.1720	20.1695	20.0592	19.5892	18.9912	18.5165	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5426	18.7621	19.1141	19.5778	19.9458	20.1363	20.1720	20.1695	20.0592	19.5892	18.9912	18.5165	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9905	0.9774	0.9371	0.8350	0.6439	0.4537	0.5085	0.7856	0.9564	0.9908	0.9965	(94)
Useful gains	488.8589	563.2682	625.5589	666.8318	634.1592	480.5018	322.8865	337.5593	479.1761	515.4323	478.0287	462.4101	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1348.2853	1308.2782	1186.9455	990.6168	762.9505	505.8679	326.3880	343.6283	547.1576	831.7326	1106.1949	1339.3087	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	639.4132	500.6468	417.6716	233.1252	95.8207	0.0000	0.0000	0.0000	0.0000	235.3274	452.2796	652.4126	(98)
Space heating												3226.6972	(98)
Space heating per m2											(98) / (4) =	40.4449	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3454.7079	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	639.4132	500.6468	417.6716	233.1252	95.8207	0.0000	0.0000	0.0000	0.0000	235.3274	452.2796	652.4126	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	684.5966	536.0244	447.1859	249.5987	102.5918	0.0000	0.0000	0.0000	0.0000	251.9566	484.2394	698.5145	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7503	87.5213	87.0461	85.9424	83.8304	80.3000	80.3000	80.3000	80.3000	85.8477	87.2379	87.8354	(217)
Fuel for water heating, kWh/month													
	230.2030	202.5567	211.8976	190.3561	188.9416	173.7253	166.4421	185.5439	187.5930	199.8079	209.8920	224.5539	(219)
Water heating fuel used												2371.5132	(219)
Annual totals kWh/year													
Space heating fuel - main system												3454.7079	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6258.1338	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3454.7079	0.2160	746.2169	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.5132	0.2160	512.2469	(264)
Space and water heating			1258.4638	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1482.6264	(272)
Emissions per m2 for space and water heating			15.7742	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7742 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.5800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

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5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	463.1837	554.5904	641.7594	731.1024	792.2441	783.0400	746.7968	687.4836	621.7718	533.0036	460.2708	434.3728	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9884	0.9785	0.9576	0.9073	0.8104	0.6614	0.5175	0.5719	0.7884	0.9374	0.9807	0.9906	(86)
MIT	19.0341	19.2815	19.6700	20.1675	20.5876	20.8572	20.9536	20.9347	20.7253	20.1687	19.5126	18.9957	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9859	0.9739	0.9481	0.8858	0.7651	0.5809	0.4068	0.4606	0.7220	0.9184	0.9757	0.9886	(89)
MIT 2	18.1158	18.3629	18.7474	19.2380	19.6257	19.8572	19.9201	19.9132	19.7592	19.2505	18.6041	18.0858	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.3055	18.5527	18.9380	19.4300	19.8244	20.0638	20.1336	20.1242	19.9587	19.4401	18.7918	18.2738	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3055	18.5527	18.9380	19.4300	19.8244	20.0638	20.1336	20.1242	19.9587	19.4401	18.7918	18.2738	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9809	0.9663	0.9373	0.8739	0.7603	0.5913	0.4283	0.4814	0.7239	0.9075	0.9687	0.9842	(94)
Useful gains	454.3213	535.8765	601.5326	638.9395	602.3121	463.0150	319.8632	330.9372	450.1003	483.7195	445.8767	427.5238	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1363.1691	1324.8891	1203.4986	1004.9116	773.3252	513.7570	332.2611	349.3850	553.5022	841.4504	1118.7557	1354.0695	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	676.1828	530.2164	447.8628	263.4999	127.2337	0.0000	0.0000	0.0000	0.0000	266.1518	484.4729	689.3500	(98)
Space heating												3484.9702	(98)
Space heating per m2											(98) / (4) =	43.6823	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8187	0.8776	0.8503	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	723.6325	610.6490	606.2446	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.1750	962.9391	895.2359	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	204.1506	262.1038	215.0095	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												681.2639	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	51.0376	65.5260	53.7524	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												170.3160	(107)
Space cooling per m2												2.1348	(108)
Energy for space heating												43.6823	(99)
Energy for space cooling												2.1348	(108)
Total												45.8171	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(77)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	104.3782	184.4148	269.9087	363.9040	434.5054	443.1968	422.3644	367.8835	302.1748	208.5588	126.2266	88.5459	(83)
Total gains	446.5894	525.2718	598.8488	673.2482	723.1655	712.5796	679.6484	628.9967	573.7314	499.8465	440.2031	420.2956	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9985	0.9965	0.9902	0.9671	0.8965	0.7427	0.5737	0.6353	0.8724	0.9814	0.9969	0.9989	(86)
MIT	19.6728	19.8344	20.0967	20.4463	20.7507	20.9346	20.9857	20.9768	20.8435	20.4457	19.9973	19.6497	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9980	0.9952	0.9866	0.9540	0.8549	0.6515	0.4477	0.5078	0.8060	0.9717	0.9956	0.9986	(89)
MIT 2	18.7216	18.8851	19.1478	19.5002	19.7816	19.9335	19.9603	19.9594	19.8706	19.5062	19.0589	18.7075	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9181	19.0812	19.3439	19.6956	19.9817	20.1403	20.1721	20.1696	20.0715	19.7003	19.2527	18.9021	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9181	19.0812	19.3439	19.6956	19.9817	20.1403	20.1721	20.1696	20.0715	19.7003	19.2527	18.9021	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9938	0.9839	0.9500	0.8563	0.6684	0.4740	0.5343	0.8145	0.9685	0.9944	0.9980	(94)
Useful gains	445.4046	522.0373	589.1874	639.6046	619.2224	476.2914	322.1453	336.0853	467.2982	484.1171	437.7201	419.4679	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1383.8307	1338.3942	1208.5618	1001.5448	766.2731	506.2326	326.3973	343.6335	548.2885	842.0068	1130.5246	1375.3854	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	698.1891	548.5918	460.8146	260.5969	109.4057	0.0000	0.0000	0.0000	0.0000	266.2699	498.8192	711.2027	(98)
Space heating												3553.8899	(98)
Space heating per m2											(98) / (4) =	44.5461	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8637	0.9242	0.8991	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	741.8790	624.9339	622.8739	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	924.8187	884.4540	826.8746	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	131.7166	193.0830	151.7765	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												476.5760	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   32.9291   48.2707   37.9441    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        119.1440 (107)
Space cooling per m2                                                                                                   1.4934 (108)
Energy for space heating                                                                                              44.5461 (99)
Energy for space cooling                                                                                               1.4934 (108)
Total                                                                                                                 46.0395 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   52.9 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(75)
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

Solar gains	134.1098	213.6762	310.3322	433.6354	506.2858	553.3328	521.3620	463.1435	377.4603	258.4019	166.2393	112.6188	(83)
Total gains	688.1022	763.2661	838.5417	928.7320	967.5087	984.2209	934.5346	884.5974	817.9836	732.2496	677.1038	651.4608	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area	0.9598	0.9427	0.9032	0.8158	0.6693	0.4554	0.3078	0.3328	0.5976	0.8383	0.9343	0.9650	(86)
MIT	19.5302	19.7242	20.0797	20.4992	20.8114	20.9643	20.9932	20.9913	20.9058	20.5363	19.9908	19.5017	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house	0.9517	0.9314	0.8836	0.7792	0.6059	0.3668	0.2042	0.2254	0.5095	0.7973	0.9191	0.9578	(89)
MIT 2	18.0067	18.2866	18.7882	19.3636	19.7529	19.9178	19.9350	19.9390	19.8697	19.4307	18.6809	17.9739	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.3214	18.5836	19.0549	19.5982	19.9716	20.1340	20.1536	20.1564	20.0837	19.6591	18.9515	18.2894	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1714	18.4336	18.9049	19.4482	19.8216	19.9840	20.0036	20.0064	19.9337	19.5091	18.8015	18.1394	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9338	0.9109	0.8608	0.7602	0.5990	0.3707	0.2108	0.2321	0.5090	0.7779	0.8979	0.9412	(94)
Useful gains	642.5656	695.2505	721.8555	706.0662	579.5482	364.8330	197.0366	205.3373	416.3792	569.5967	607.9852	613.1777	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1258.1298	1227.6769	1100.5784	905.4672	646.8981	373.7948	197.8724	206.4959	444.1374	745.9305	1018.7232	1240.0586	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	457.9798	357.7905	281.7699	143.5687	50.1083	0.0000	0.0000	0.0000	0.0000	131.1924	295.7313	466.3993	(98)

Space heating 2184.5402 (98)
RHI space heating demand 2185 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	674.9649	763.3234	841.0289	916.8548	964.8069	944.5453	902.6854	847.8243	790.7385	715.5636	657.1589	641.4651	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9672	0.9502	0.9184	0.8516	0.7396	0.5825	0.4438	0.4860	0.6954	0.8780	0.9499	0.9716	(86)
MIT	19.3188	19.5478	19.8992	20.3401	20.6887	20.9008	20.9698	20.9589	20.8135	20.3654	19.7759	19.2845	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9606	0.9405	0.9022	0.8218	0.6877	0.5031	0.3435	0.3839	0.6212	0.8468	0.9384	0.9659	(89)
MIT 2	17.6829	18.0130	18.5143	19.1357	19.5919	19.8485	19.9109	19.9063	19.7581	19.1870	18.3564	17.6425	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0208	18.3300	18.8004	19.3845	19.8185	20.0659	20.1296	20.1237	19.9761	19.4304	18.6496	17.9817	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8708	18.1800	18.6504	19.2345	19.6685	19.9159	19.9796	19.9737	19.8261	19.2804	18.4996	17.8317	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9440	0.9204	0.8791	0.8000	0.6748	0.5023	0.3487	0.3884	0.6140	0.8245	0.9185	0.9507	(94)
Useful gains	637.1879	702.5815	739.3776	733.4790	651.0531	474.4139	314.7756	329.2968	485.4813	589.9940	603.5890	609.8578	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1347.0313	1313.3484	1197.3068	1001.0952	769.4100	505.5438	321.4042	338.9016	547.7641	838.1480	1107.9186	1333.8647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	528.1235	410.4354	340.6993	192.6837	88.0576	0.0000	0.0000	0.0000	0.0000	184.6265	363.1173	538.6611	(98)
Space heating												2646.4044	(98)
Space heating per m2											(98) / (4) =	33.1713	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2924.2037	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	528.1235	410.4354	340.6993	192.6837	88.0576	0.0000	0.0000	0.0000	0.0000	184.6265	363.1173	538.6611	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	583.5619	453.5197	376.4634	212.9102	97.3012	0.0000	0.0000	0.0000	0.0000	204.0072	401.2346	595.2056	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7166	89.6429	89.4954	89.1687	88.5763	87.3000	87.3000	87.3000	87.3000	89.1062	89.5480	89.7452	(217)
Fuel for water heating, kWh/month													
	184.0952	161.5758	168.0375	148.5039	144.5439	128.1956	120.4190	135.8687	136.8056	154.2412	165.6466	178.7131	(219)
Water heating fuel used												1826.6460	(219)
Annual totals kWh/year													
Space heating fuel - main system												2924.2037	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5182.7623	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2924.2037	3.4800	101.7623	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.6460	3.4800	63.5673	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			342.2988	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1522	(257)
SAP value		83.9275	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2924.2037	0.2160	631.6280	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.6460	0.2160	394.5555	(264)
Space and water heating			1026.1835	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1250.3462	(272)
CO2 emissions per m2			15.6700	(273)
EI value			86.5727	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	12.9236	0.4600	0.0000	0.7700	3.2958	(75)
Southeast	3.0000	40.4699	0.4600	0.0000	0.7700	43.0033	(77)
Northwest	5.0600	12.9236	0.4600	0.0000	0.7700	23.1623	(81)
Southeast	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(77)

Solar gains	134.1098	213.6762	310.3322	433.6354	506.2858	553.3328	521.3620	463.1435	377.4603	258.4019	166.2393	112.6188	(83)
Total gains	688.1022	763.2661	838.5417	928.7320	967.5087	984.2209	934.5346	884.5974	817.9836	732.2496	677.1038	651.4608	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9598	0.9427	0.9032	0.8158	0.6693	0.4554	0.3078	0.3328	0.5976	0.8383	0.9343	0.9650	(86)
MIT	19.5302	19.7242	20.0797	20.4992	20.8114	20.9643	20.9932	20.9913	20.9058	20.5363	19.9908	19.5017	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9517	0.9314	0.8836	0.7792	0.6059	0.3668	0.2042	0.2254	0.5095	0.7973	0.9191	0.9578	(89)
MIT 2	18.0067	18.2866	18.7882	19.3636	19.7529	19.9178	19.9350	19.9390	19.8697	19.4307	18.6809	17.9739	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3214	18.5836	19.0549	19.5982	19.9716	20.1340	20.1536	20.1564	20.0837	19.6591	18.9515	18.2894	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1714	18.4336	18.9049	19.4482	19.8216	19.9840	20.0036	20.0064	19.9337	19.5091	18.8015	18.1394	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9338	0.9109	0.8608	0.7602	0.5990	0.3707	0.2108	0.2321	0.5090	0.7779	0.8979	0.9412	(94)
Useful gains	642.5656	695.2505	721.8555	706.0662	579.5482	364.8330	197.0366	205.3373	416.3792	569.5967	607.9852	613.1777	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1258.1298	1227.6769	1100.5784	905.4672	646.8981	373.7948	197.8724	206.4959	444.1374	745.9305	1018.7232	1240.0586	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	457.9798	357.7905	281.7699	143.5687	50.1083	0.0000	0.0000	0.0000	0.0000	131.1924	295.7313	466.3993	(98)
Space heating												2184.5402	(98)
Space heating per m2											(98) / (4) =	27.3821	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2413.8566	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	457.9798	357.7905	281.7699	143.5687	50.1083	0.0000	0.0000	0.0000	0.0000	131.1924	295.7313	466.3993	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	506.0550	395.3487	311.3479	158.6395	55.3683	0.0000	0.0000	0.0000	0.0000	144.9639	326.7749	515.3584	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6292	89.5541	89.3602	88.9359	88.1770	87.3000	87.3000	87.3000	87.3000	88.8340	89.4053	89.6590	(217)
Fuel for water heating, kWh/month													
	184.2746	161.7361	168.2918	148.8926	145.1984	128.1956	120.4190	135.8687	136.8056	154.7137	165.9110	178.8849	(219)
Water heating fuel used												1829.1921	(219)
Annual totals kWh/year													
Space heating fuel - main system												2413.8566	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4674.9613	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2413.8566	3.9200	94.6232	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1829.1921	3.9200	71.7043	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			327.5799	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2413.8566	0.2160	521.3930	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.1921	0.2160	395.1055	(264)
Space and water heating			916.4985	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1140.6612	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2413.8566	1.2200	2944.9051	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.1921	1.2200	2231.6143	(264)
Space and water heating			5176.5194	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6502.4912	(272)
Primary energy kWh/m2/year			81.5053	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.9%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (98.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£254	£217	£38
Space heating	£195	£195	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£327	-£10	£339
Total cost of uses	£328	-£10	£338
Delivered energy	59 kWh/m²	24 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	82 kWh/m²	-1 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(77)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(77)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	674.9649	763.3234	841.0289	916.8548	964.8069	944.5453	902.6854	847.8243	790.7385	715.5636	657.1589	641.4651	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9672	0.9502	0.9184	0.8516	0.7396	0.5825	0.4438	0.4860	0.6954	0.8780	0.9499	0.9716	(86)
MIT	19.3188	19.5478	19.8992	20.3401	20.6887	20.9008	20.9698	20.9589	20.8135	20.3654	19.7759	19.2845	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9606	0.9405	0.9022	0.8218	0.6877	0.5031	0.3435	0.3839	0.6212	0.8468	0.9384	0.9659	(89)
MIT 2	17.6829	18.0130	18.5143	19.1357	19.5919	19.8485	19.9109	19.9063	19.7581	19.1870	18.3564	17.6425	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.0208	18.3300	18.8004	19.3845	19.8185	20.0659	20.1296	20.1237	19.9761	19.4304	18.6496	17.9817	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8708	18.1800	18.6504	19.2345	19.6685	19.9159	19.9796	19.9737	19.8261	19.2804	18.4996	17.8317	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9440	0.9204	0.8791	0.8000	0.6748	0.5023	0.3487	0.3884	0.6140	0.8245	0.9185	0.9507	(94)
Useful gains	637.1879	702.5815	739.3776	733.4790	651.0531	474.4139	314.7756	329.2968	485.4813	589.9940	603.5890	609.8578	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1347.0313	1313.3484	1197.3068	1001.0952	769.4100	505.5438	321.4042	338.9016	547.7641	838.1480	1107.9186	1333.8647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	528.1235	410.4354	340.6993	192.6837	88.0576	0.0000	0.0000	0.0000	0.0000	184.6265	363.1173	538.6611	(98)

Space heating 2646.4044 (98)
Space heating per m2 (98) / (4) = 33.1713 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2924.2037 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	528.1235	410.4354	340.6993	192.6837	88.0576	0.0000	0.0000	0.0000	0.0000	184.6265	363.1173	538.6611	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	583.5619	453.5197	376.4634	212.9102	97.3012	0.0000	0.0000	0.0000	0.0000	204.0072	401.2346	595.2056	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8075	89.8341	89.8680	89.9419	90.0767	87.3000	87.3000	87.3000	87.3000	89.4640	89.6869	89.8211	(217)
Fuel for water heating, kWh/month	156.6764	115.8022	89.9980	43.6579	14.3765	0.0000	0.0000	24.1300	49.2919	95.3083	133.0450	155.7766	(219)

Water heating fuel used 878.0628 (219)
Annual totals kWh/year
Space heating fuel - main system 2924.2037 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 356.9126 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 2556.9398 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2924.2037	3.4800	101.7623	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.0628	3.4800	30.5566	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			88.0603	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.2964 (257)
SAP value 95.8652
SAP rating (Section 12) 96 (258)
SAP band A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2924.2037	0.2160	631.6280	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.0628	0.2160	189.6616	(264)
Space and water heating			821.2896	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			174.9650	(272)
CO2 emissions per m2			2.1900	(273)
EI value			98.1211	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
              165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3147 (H8)
Utilisation factor                                                                                                                  0.5326 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -859.2180 (H17)
Solar input    -26.4463   -39.7487   -66.9419   -92.5342  -111.4423  -117.2882  -114.4719  -102.2241   -79.7862   -54.2771   -32.1462   -21.9109 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -859.2180 (63)
Output from w/h
              138.7176   105.0925    83.4439    39.8847    16.5893     0.0000     0.0000    16.3893    39.6451    83.1613   116.1870   138.4756 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =     777.5864 (64)
Heat gains from water heating, kWh/month
               53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
               72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
              553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF           Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2     or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
Northeast                              0.7200           12.9236           0.4600           0.0000           0.7700           3.2958 (75)
Southeast                              3.0000           40.4699           0.4600           0.0000           0.7700          43.0033 (77)
Northwest                              5.0600           12.9236           0.4600           0.0000           0.7700          23.1623 (81)
Southeast                              4.5100           40.4699           0.4600           0.0000           0.7700          64.6483 (77)
-------------------------------------------------------------------------------------------------------------

Solar gains    134.1098   213.6762   310.3322   433.6354   506.2858   553.3328   521.3620   463.1435   377.4603   258.4019   166.2393   112.6188 (83)
Total gains    688.1022   763.2661   838.5417   928.7320   967.5087   984.2209   934.5346   884.5974   817.9836   732.2496   677.1038   651.4608 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            34.7290    34.9430    34.9430    35.2490    35.2490    35.6271    35.5359    35.7161    35.6271    35.4424    35.4424    35.1491
alpha           3.3153     3.3295     3.3295     3.3499     3.3499     3.3751     3.3691     3.3811     3.3751     3.3628     3.3628     3.3433
util living area
                0.9598     0.9427     0.9032     0.8158     0.6693     0.4554     0.3078     0.3328     0.5976     0.8383     0.9343     0.9650 (86)

MIT            19.5302    19.7242    20.0797    20.4992    20.8114    20.9643    20.9932    20.9913    20.9058    20.5363    19.9908    19.5017 (87)
Th 2           19.9148    19.9207    19.9207    19.9291    19.9291    19.9392    19.9368    19.9416    19.9392    19.9343    19.9343    19.9264 (88)
util rest of house
                0.9517     0.9314     0.8836     0.7792     0.6059     0.3668     0.2042     0.2254     0.5095     0.7973     0.9191     0.9578 (89)
MIT 2          18.0067    18.2866    18.7882    19.3636    19.7529    19.9178    19.9350    19.9390    19.8697    19.4307    18.6809    17.9739 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT            18.3214    18.5836    19.0549    19.5982    19.9716    20.1340    20.1536    20.1564    20.0837    19.6591    18.9515    18.2894 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT   18.1714    18.4336    18.9049    19.4482    19.8216    19.9840    20.0036    20.0064    19.9337    19.5091    18.8015    18.1394 (93)
```

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9338	0.9109	0.8608	0.7602	0.5990	0.3707	0.2108	0.2321	0.5090	0.7779	0.8979	0.9412	(94)
Useful gains	642.5656	695.2505	721.8555	706.0662	579.5482	364.8330	197.0366	205.3373	416.3792	569.5967	607.9852	613.1777	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1258.1298	1227.6769	1100.5784	905.4672	646.8981	373.7948	197.8724	206.4959	444.1374	745.9305	1018.7232	1240.0586	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	457.9798	357.7905	281.7699	143.5687	50.1083	0.0000	0.0000	0.0000	0.0000	131.1924	295.7313	466.3993	(98)
Space heating												2184.5402	(98)
Space heating per m2											(98) / (4) =	27.3821	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2413.8566	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	457.9798	357.7905	281.7699	143.5687	50.1083	0.0000	0.0000	0.0000	0.0000	131.1924	295.7313	466.3993	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	506.0550	395.3487	311.3479	158.6395	55.3683	0.0000	0.0000	0.0000	0.0000	144.9639	326.7749	515.3584	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7353	89.7531	89.7484	89.7845	89.6824	87.3000	87.3000	87.3000	87.3000	89.2311	89.5739	89.7469	(217)
Fuel for water heating, kWh/month	154.5853	117.0907	92.9754	44.4228	18.4979	0.0000	0.0000	18.7735	45.4125	93.1977	129.7108	154.2957	(219)
Water heating fuel used												868.9623	(219)
Annual totals kWh/year													
Space heating fuel - main system												2413.8566	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												1940.5719	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2413.8566	3.9200	94.6232	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.9623	3.9200	34.0633	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-10.9586	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2413.8566	0.2160	521.3930	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.9623	0.2160	187.6959	(264)
Space and water heating			709.0889	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			12.4627	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2413.8566	1.2200	2944.9051	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.9623	1.2200	1060.1340	(264)
Space and water heating			4005.0391	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-115.6592	(272)
Primary energy kWh/m2/year			-1.4497	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.7200	98.8453	0.4600	0.0000	0.9000	29.4638
South East	3.0000	119.9223	0.4600	0.0000	0.9000	148.9436
North West	5.0600	98.8453	0.4600	0.0000	0.9000	207.0650
South East	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						609.3842

	Jun	Jul	Aug	
Solar gains	647	609	541	(P4)
Internal gains	428	410	418	
Total summer gains	1075	1020	960	(P5)
Summer gain/loss ratio	3.28	3.11	2.93	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.22	21.95	21.67	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-341	**Issued on Date**	19/10/2022
Assessment Reference	Plot 341	**Prop Type Ref**	2BMW-As-DET
Property	Plot 341, 2 Bed, K, B		

SAP Rating	84 B	**DER**	17.00	**TER**	19.16
Environmental	87 B	**% DER<TER**	11.28		
CO_2 Emissions (t/year)	1.07	**DFEE**	46.02	**TFEE**	56.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.89		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached Maisonette, total floor area 77 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.16 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.00 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.0 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 1.04 m², No overhang
Windows facing North East: 0.82 m², No overhang
Windows facing South East: 2.61 m², No overhang
Windows facing South West: 3.40 m², No overhang
Windows facing West: 1.04 m², No overhang
Windows facing North West: 7.32 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.08 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3610	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3339	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4257	0.4174	0.4090	0.3673	0.3589	0.3172	0.3172	0.3089	0.3339	0.3589	0.3756	0.3923	(22b)
Effective ac	0.5906	0.5871	0.5837	0.5674	0.5644	0.5503	0.5503	0.5477	0.5557	0.5644	0.5706	0.5770	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.2865	35.0763	34.8702	33.9023	33.7213	32.8782	32.8782	32.7221	33.2030	33.7213	34.0876	34.4706	(38)
Heat transfer coeff	93.2687	93.0585	92.8524	91.8845	91.7034	90.8604	90.8604	90.7043	91.1851	91.7034	92.0698	92.4528	(39)
Average = Sum(39)m / 12 =												91.8836	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.2028	1.2001	1.1876	1.1853	1.1744	1.1744	1.1723	1.1786	1.1853	1.1900	1.1949	(40)
HLP (average)												1.1876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4111 (42)
Average daily hot water use (litres/day)		91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6645	13.2206	14.5938	14.0740	14.5074	13.9983	14.4393	14.4835	14.0396	14.5581	14.1453	14.6504 (61)

Total heat required for water heating calculated for each month

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (64)
								Total per year (kWh/year) = Sum(64)m =				1610.4406 (64)

Heat gains from water heating, kWh/month

	53.2752	46.6936	48.4214	42.5527	41.0811	35.8197	33.5592	37.9882	38.2877	44.1697	47.7782	51.7064 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4333	19.6506 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	213.8562	216.0754	210.4832	198.5780	183.5499	169.4256	159.9897	157.7705	163.3627	175.2679	190.2960	204.4203 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426 (71)

Water heating gains (Table 5)

	71.6065	69.4845	65.0826	59.1009	55.2165	49.7496	45.1065	51.0594	53.1773	59.3678	66.3586	69.4978 (72)

Total internal gains

	366.7479	364.7074	351.5420	330.3002	308.7478	287.9393	274.3916	280.2631	291.1445	312.5951	337.2538	355.7347 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.4600	0.0000	0.7700	3.9170	(74)
Northeast	0.8200	11.2829	0.4600	0.0000	0.7700	3.2771	(75)
Southeast	2.6100	36.7938	0.4600	0.0000	0.7700	34.0145	(77)
Southwest	3.4000	36.7938	0.4600	0.0000	0.7700	44.3101	(79)
West	1.0400	19.6403	0.4600	0.0000	0.7700	7.2348	(80)
Northwest	2.8100	11.2829	0.4600	0.0000	0.7700	11.2299	(81)
Northwest	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(81)

Solar gains	122.0073	221.2717	337.8757	476.5362	585.8934	604.3991	573.2548	488.3175	385.4315	254.0800	148.6001	102.8108	(83)
Total gains	488.7551	585.9790	689.4177	806.8364	894.6412	892.3384	847.6464	768.5806	676.5760	566.6751	485.8539	458.5455	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5793	59.7139	59.8464	60.4768	60.5963	61.1585	61.1585	61.2637	60.9407	60.5963	60.3551	60.1051	
alpha	4.9720	4.9809	4.9898	5.0318	5.0398	5.0772	5.0772	5.0842	5.0627	5.0398	5.0237	5.0070	
util living area	0.9978	0.9943	0.9824	0.9361	0.8138	0.6238	0.4661	0.5315	0.8033	0.9692	0.9952	0.9984	(86)
MIT	19.7479	19.9279	20.2162	20.5814	20.8535	20.9707	20.9945	20.9897	20.8993	20.5249	20.0656	19.7156	(87)
Th 2	19.9156	19.9178	19.9199	19.9299	19.9318	19.9406	19.9406	19.9422	19.9372	19.9318	19.9280	19.9240	(88)
util rest of house	0.9971	0.9923	0.9760	0.9134	0.7565	0.5323	0.3568	0.4151	0.7217	0.9539	0.9932	0.9979	(89)
MIT 2	18.2544	18.5183	18.9364	19.4544	19.7975	19.9228	19.9387	19.9383	19.8615	19.3895	18.7274	18.2133	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	18.5725	18.8185	19.2090	19.6945	20.0224	20.1460	20.1636	20.1623	20.0825	19.6314	19.0124	18.5333	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4225	18.6685	19.0590	19.5445	19.8724	19.9960	20.0136	20.0123	19.9325	19.4814	18.8624	18.3833	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9889	0.9690	0.9032	0.7529	0.5373	0.3645	0.4231	0.7213	0.9449	0.9901	0.9966	(94)
Useful gains	486.5259	579.4607	668.0354	728.7435	673.5864	479.4390	308.9656	325.1727	488.0194	535.4782	481.0383	456.9948	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1317.1881	1281.2779	1166.1365	978.0625	749.4374	490.2851	310.1619	327.6498	531.8388	814.4527	1082.9615	1311.2866	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	618.0127	471.6212	370.5872	179.5097	56.4331	0.0000	0.0000	0.0000	0.0000	207.5570	433.3847	635.5931	(98)
Space heating												2972.6987	(98)
Space heating per m2											(98) / (4) =	38.4219	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3284.7499	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	618.0127	471.6212	370.5872	179.5097	56.4331	0.0000	0.0000	0.0000	0.0000	207.5570	433.3847	635.5931	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	682.8869	521.1284	409.4886	198.3533	62.3571	0.0000	0.0000	0.0000	0.0000	229.3448	478.8781	702.3128	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8101	89.7318	89.5575	89.1190	88.2593	87.3000	87.3000	87.3000	87.3000	89.2030	89.6667	89.8406	(217)
Fuel for water heating, kWh/month													
	182.4571	160.1574	166.6520	147.5219	144.0661	127.3789	119.7166	134.9873	135.8928	152.9693	164.1674	177.1393	(219)
Water heating fuel used												1813.1063	(219)
Annual totals kWh/year													
Space heating fuel - main system												3284.7499	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Total delivered energy for all uses												5510.5072	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3284.7499	0.2160	709.5060	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1813.1063	0.2160	391.6310	(264)
Space and water heating			1101.1369	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Total CO2, kg/year			1315.3028	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.0000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.0000	ZC1
Total Floor Area	TFA	77.3700	
Assumed number of occupants	N	2.4111	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.3793	ZC2
CO2 emissions from cooking, equation (L16)		2.2860	ZC3
Total CO2 emissions		35.6653	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.6653	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1657	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4157	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3845	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4903	0.4807	0.4710	0.4230	0.4134	0.3653	0.3653	0.3557	0.3845	0.4134	0.4326	0.4518	(22b)
Effective ac	0.6202	0.6155	0.6109	0.5895	0.5854	0.5667	0.5667	0.5633	0.5739	0.5854	0.5936	0.6021	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			16.2300	1.3258	21.5170			(27)
GF B&B J150 P/A=0.50			77.3700	0.1300	10.0581			(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.1800	12.2652			(29a)
Bay	1.0400		1.0400	0.1300	0.1352			(30)
Ceiling to void	10.8400		10.8400	0.1300	1.4092			(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.5147			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2107	(36)
Total fabric heat loss					(33) + (36) =		59.7254	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.0529	36.7741	36.5008	35.2171	34.9769	33.8589	33.8589	33.6518	34.2895	34.9769	35.4628	35.9707	(38)
Heat transfer coeff	96.7783	96.4995	96.2262	94.9425	94.7024	93.5843	93.5843	93.3773	94.0150	94.7024	95.1882	95.6962	(39)
Average = Sum(39)m / 12 =												94.9414	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2472	1.2437	1.2271	1.2240	1.2096	1.2096	1.2069	1.2151	1.2240	1.2303	1.2369	(40)
HLP (average)												1.2271	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4111	(42)
Average daily hot water use (litres/day)												91.4628	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)
Distribution loss (46)m = 0.15 x (45)m	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	44.6238	47.5406	44.2028	43.8119	40.5944	41.9476	43.8119	44.2028	47.5406	47.8112	50.9589	(61)
Total heat required for water heating calculated for each month													
	200.1592	175.1154	182.1962	161.5989	156.4562	137.7979	132.0209	147.1723	148.7977	169.4358	180.8694	195.4515	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	200.1592	175.1154	182.1962	161.5989	156.4562	137.7979	132.0209	147.1723	148.7977	169.4358	180.8694	195.4515	(64)
								Total per year (kWh/year) = Sum(64)m =				1987.0714	(64)
Heat gains from water heating, kWh/month													
	62.3488	54.5444	56.6581	50.0849	48.4072	42.4688	40.4363	45.3203	45.8285	52.4153	56.1946	60.7835	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4333	19.6506	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	213.8562	216.0754	210.4832	198.5780	183.5499	169.4256	159.9897	157.7705	163.3627	175.2679	190.2960	204.4203	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	(71)
Water heating gains (Table 5)													
	83.8022	81.1673	76.1534	69.5623	65.0634	58.9844	54.3498	60.9144	63.6507	70.4507	78.0481	81.6983	(72)
Total internal gains													
	378.9436	376.3901	362.6128	340.7616	318.5948	297.1741	283.6350	290.1181	301.6178	323.6780	348.9434	367.9351	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.6300	0.7000	0.7700	3.3797	(74)
Northeast	0.8200	11.2829	0.6300	0.7000	0.7700	2.8275	(75)
Southeast	2.6100	36.7938	0.6300	0.7000	0.7700	29.3486	(77)
Southwest	3.4000	36.7938	0.6300	0.7000	0.7700	38.2319	(79)
West	1.0400	19.6403	0.6300	0.7000	0.7700	6.2424	(80)
Northwest	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(81)

Solar gains	105.2710	190.9190	291.5280	411.1679	505.5241	521.4913	494.6192	421.3331	332.5604	219.2269	128.2161	88.7079	(83)
Total gains	484.2146	567.3091	654.1408	751.9295	824.1189	818.6654	778.2541	711.4512	634.1782	542.9048	477.1594	456.6430	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5178	55.6782	55.8363	56.5913	56.7348	57.4126	57.4126	57.5399	57.1496	56.7348	56.4452	56.1456	
alpha	4.7012	4.7119	4.7224	4.7728	4.7823	4.8275	4.8275	4.8360	4.8100	4.7823	4.7630	4.7430	
util living area													
	0.9976	0.9945	0.9850	0.9500	0.8533	0.6798	0.5173	0.5817	0.8371	0.9731	0.9950	0.9982	(86)
MIT	19.6493	19.8198	20.1037	20.4799	20.7874	20.9491	20.9890	20.9812	20.8587	20.4531	19.9851	19.6236	(87)
Th 2	19.8795	19.8824	19.8852	19.8984	19.9008	19.9124	19.9124	19.9145	19.9079	19.9008	19.8958	19.8906	(88)
util rest of house													
	0.9967	0.9926	0.9795	0.9313	0.8016	0.5846	0.3955	0.4553	0.7607	0.9596	0.9930	0.9975	(89)
MIT 2	18.0899	18.3404	18.7537	19.2953	19.6974	19.8797	19.9085	19.9070	19.7961	19.2696	18.5918	18.0599	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	18.4220	18.6555	19.0413	19.5476	19.9295	20.1074	20.1386	20.1358	20.0225	19.5217	18.8886	18.3930	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4220	18.6555	19.0413	19.5476	19.9295	20.1074	20.1386	20.1358	20.0225	19.5217	18.8886	18.3930	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9895	0.9738	0.9238	0.8032	0.6028	0.4215	0.4822	0.7700	0.9533	0.9901	0.9962	(94)
Useful gains	481.8284	561.3451	637.0109	694.6439	661.9183	493.4783	328.0630	343.0881	488.3101	517.5333	472.4559	454.9166	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1366.7071	1327.3991	1206.8005	1010.9144	779.3574	515.4101	331.1597	348.8417	556.8000	844.9070	1122.1332	1358.2130	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	658.3498	514.7883	423.9235	227.7147	87.3747	0.0000	0.0000	0.0000	0.0000	243.5660	467.7677	672.0525	(98)
Space heating												3295.5372	(98)
Space heating per m2											(98) / (4) =	42.5945	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3528.4124	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	658.3498	514.7883	423.9235	227.7147	87.3747	0.0000	0.0000	0.0000	0.0000	243.5660	467.7677	672.0525	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	704.8713	551.1652	453.8796	243.8059	93.5489	0.0000	0.0000	0.0000	0.0000	260.7773	500.8219	719.5423	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	200.1592	175.1154	182.1962	161.5989	156.4562	137.7979	132.0209	147.1723	148.7977	169.4358	180.8694	195.4515	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8246	87.6032	87.1066	85.9145	83.6490	80.3000	80.3000	80.3000	80.3000	85.9642	87.3369	87.9088	(217)
Fuel for water heating, kWh/month													
	227.9081	199.8961	209.1645	188.0927	187.0390	171.6038	164.4096	183.2781	185.3022	197.1006	207.0940	222.3343	(219)
Water heating fuel used												2343.2230	(219)
Annual totals kWh/year													
Space heating fuel - main system												3528.4124	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Total delivered energy for all uses												6284.2865	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3528.4124	0.2160	762.1371	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2343.2230	0.2160	506.1362	(264)
Space and water heating			1268.2733	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Total CO2, kg/m2/year			1482.4391	(272)
Emissions per m2 for space and water heating			16.3923	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2650	(272b)
Emissions per m2 for pumps and fans			0.5031	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3923 * 1.00) + 2.2650 + 0.5031, rounded to 2 d.p.			19.1600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1657	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4162	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3850	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4909	0.4812	0.4716	0.4235	0.4139	0.3657	0.3657	0.3561	0.3850	0.4139	0.4331	0.4524	(22b)
Effective ac	0.6205	0.6158	0.6112	0.5897	0.5856	0.5669	0.5669	0.5634	0.5741	0.5856	0.5938	0.6023	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			30.0000	2289.9000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16951.5820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		219.0976 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.0702	36.7907	36.5167	35.2300	34.9892	33.8685	33.8685	33.6609	34.3002	34.9892	35.4762	35.9854	(38)
Heat transfer coeff	95.0523	94.7728	94.4989	93.2121	92.9714	91.8506	91.8506	91.6431	92.2823	92.9714	93.4584	93.9676	(39)
Average = Sum(39)m / 12 =												93.2110	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2249	1.2214	1.2048	1.2016	1.1872	1.1872	1.1845	1.1927	1.2016	1.2079	1.2145	(40)
HLP (average)												1.2047	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4111 (42)
Average daily hot water use (litres/day)	91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (46)
Water storage loss:
Total storage loss
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Primary loss   0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (59)
Heat gains from water heating, kWh/month
              31.7051   27.7295   28.6143   24.9467   23.9369   20.6557   19.1406   21.9641   22.2264   25.9027   28.2749   30.7047 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532  120.5532 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.1192   16.9815   13.8103   10.4553    7.8154    6.5981    7.1295    9.2672   12.4384   15.7934   18.4333   19.6506 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             213.8562  216.0754  210.4832  198.5780  183.5499  169.4256  159.9897  157.7705  163.3627  175.2679  190.2960  204.4203 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553   35.0553 (69)
Pumps, fans    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426  -96.4426 (71)
Water heating gains (Table 5)
              42.6143   41.2641   38.4601   34.6481   32.1733   28.6885   25.7266   29.5216   30.8700   34.8155   39.2706   41.2697 (72)
Total internal gains
             334.7557  333.4869  321.9195  302.8474  282.7046  263.8782  252.0117  255.7253  265.8371  285.0428  307.1659  324.5066 (73)


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6. Solar gains
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[Jan]                                  Area        Solar flux              g              FF          Access          Gains
                                       m2          Table 6a     Specific data  Specific data      factor           W
                                                     W/m2       or Table 6b    or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------
North                                 1.0400          10.6334          0.4600          0.0000          0.7700          3.9170 (74)
Northeast                             0.8200          11.2829          0.4600          0.0000          0.7700          3.2771 (75)
Southeast                             2.6100          36.7938          0.4600          0.0000          0.7700         34.0145 (77)
Southwest                             3.4000          36.7938          0.4600          0.0000          0.7700         44.3101 (79)
West                                  1.0400          19.6403          0.4600          0.0000          0.7700          7.2348 (80)
Northwest                             2.8100          11.2829          0.4600          0.0000          0.7700         11.2299 (81)
Northwest                             4.5100          11.2829          0.4600          0.0000          0.7700         18.0238 (81)
-------------------------------------------------------------------------------------------------------------

Solar gains   122.0073  221.2717  337.8757  476.5362  585.8934  604.3991  573.2548  488.3175  385.4315  254.0800  148.6001  102.8108 (83)
Total gains   456.7630  554.7586  659.7952  779.3836  868.5980  868.2773  825.2665  744.0428  651.2687  539.1228  455.7660  427.3174 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           49.5387   49.6848   49.8289   50.5167   50.6476   51.2655   51.2655   51.3816   51.0257   50.6476   50.3836   50.1106
alpha          4.3026    4.3123    4.3219    4.3678    4.3765    4.4177    4.4177    4.4254    4.4017    4.3765    4.3589    4.3407
util living area
               0.9966    0.9919    0.9775    0.9287    0.8121    0.6326    0.4788    0.5458    0.8056    0.9641    0.9932    0.9975 (86)

MIT           19.5007   19.7071   20.0381   20.4624   20.7880   20.9485   20.9880   20.9793   20.8505   20.4047   19.8745   19.4696 (87)
Th 2          19.8972   19.9001   19.9029   19.9162   19.9187   19.9303   19.9303   19.9324   19.9258   19.9187   19.9137   19.9084 (88)
util rest of house
               0.9956    0.9894    0.9705    0.9064    0.7584    0.5434    0.3677    0.4288    0.7295    0.9486    0.9908    0.9967 (89)
MIT 2         18.5361   18.7435   19.0724   19.4899   19.7784   19.9065   19.9271   19.9262   19.8424   19.4461   18.9217   18.5138 (90)
Living area fraction                                                                  fLA = Living area / (4) =     0.2130 (91)
MIT           18.7416   18.9487   19.2781   19.6970   19.9935   20.1285   20.1530   20.1505   20.0571   19.6503   19.1246   18.7174 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  18.7416   18.9487   19.2781   19.6970   19.9935   20.1285   20.1530   20.1505   20.0571   19.6503   19.1246   18.7174 (93)


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8. Space heating requirement
-------------------------------------------------------------------------------------------------------------

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9941    0.9865    0.9653    0.9011    0.7626    0.5608    0.3915    0.4537    0.7400    0.9436    0.9883    0.9955 (94)
Useful gains 454.0770  547.2670  636.9176  702.2729  662.3532  486.9426  323.0531  337.5539  481.9600  508.7407  450.4222  425.4110 (95)
Ext temp.      4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            1372.7047 1331.4393 1207.5167 1006.4140  771.0561  507.7942  326.3495  343.7103  549.7381  841.4163 1123.8016 1364.1604 (97)
Month fracti   1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             683.4591  526.9638  424.5257  218.9816   80.8750    0.0000    0.0000    0.0000    0.0000  247.5106  484.8332  698.4296 (98)
Space heating                                                                                            3365.5785 (98)
Space heating per m2                                                                          (98) / (4) =    43.4998 (99)


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8c. Space cooling requirement
-------------------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	863.3959	679.6946	696.4874	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9002	0.9434	0.9193	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	777.2197	641.2080	640.2859	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1104.5971	1052.4777	959.0275	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	235.7117	305.9846	237.1438	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												778.8401	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	58.9279	76.4962	59.2859	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												194.7100	(107)
Space cooling per m2												2.5166	(108)
Energy for space heating												43.4998	(99)
Energy for space cooling												2.5166	(108)
Total												46.0164	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1657	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4157	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3845	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4903	0.4807	0.4710	0.4230	0.4134	0.3653	0.3653	0.3557	0.3845	0.4134	0.4326	0.4518	(22b)
Effective ac	0.6202	0.6155	0.6109	0.5895	0.5854	0.5667	0.5667	0.5633	0.5739	0.5854	0.5936	0.6021	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			16.2300	1.3258	21.5170			(27)
GF B&B J150 P/A=0.50			77.3700	0.1300	10.0581			(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.1800	12.2652			(29a)
Bay	1.0400		1.0400	0.1300	0.1352			(30)
Ceiling to void	10.8400		10.8400	0.1300	1.4092			(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.5147			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2107	(36)
Total fabric heat loss						(33) + (36) =	59.7254	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.0529	36.7741	36.5008	35.2171	34.9769	33.8589	33.8589	33.6518	34.2895	34.9769	35.4628	35.9707	(38)
Heat transfer coeff	96.7783	96.4995	96.2262	94.9425	94.7024	93.5843	93.5843	93.3773	94.0150	94.7024	95.1882	95.6962	(39)
Average = Sum(39)m / 12 =												94.9414	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2472	1.2437	1.2271	1.2240	1.2096	1.2096	1.2069	1.2151	1.2240	1.2303	1.2369	(40)
HLP (average)												1.2271	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4111	(42)
Average daily hot water use (litres/day)												91.4628	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	31.7051	27.7295	28.6143	24.9467	23.9369	20.6557	19.1406	21.9641	22.2264	25.9027	28.2749	30.7047	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	120.5532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.1192	16.9815	13.8103	10.4553	7.8154	6.5981	7.1295	9.2672	12.4384	15.7934	18.4333	19.6506	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	213.8562	216.0754	210.4832	198.5780	183.5499	169.4256	159.9897	157.7705	163.3627	175.2679	190.2960	204.4203	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	35.0553	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	(71)
Water heating gains (Table 5)													
	42.6143	41.2641	38.4601	34.6481	32.1733	28.6885	25.7266	29.5216	30.8700	34.8155	39.2706	41.2697	(72)
Total internal gains													
	334.7557	333.4869	321.9195	302.8474	282.7046	263.8782	252.0117	255.7253	265.8371	285.0428	307.1659	324.5066	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	10.6334	0.6300	0.7000	0.7700	3.3797	(74)
Northeast	0.8200	11.2829	0.6300	0.7000	0.7700	2.8275	(75)
Southeast	2.6100	36.7938	0.6300	0.7000	0.7700	29.3486	(77)
Southwest	3.4000	36.7938	0.6300	0.7000	0.7700	38.2319	(79)
West	1.0400	19.6403	0.6300	0.7000	0.7700	6.2424	(80)
Northwest	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(81)

Solar gains	105.2710	190.9190	291.5280	411.1679	505.5241	521.4913	494.6192	421.3331	332.5604	219.2269	128.2161	88.7079	(83)
Total gains	440.0268	524.4059	613.4475	714.0153	788.2287	785.3695	746.6309	677.0584	598.3975	504.2697	435.3819	413.2144	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5178	55.6782	55.8363	56.5913	56.7348	57.4126	57.4126	57.5399	57.1496	56.7348	56.4452	56.1456	
alpha	4.7012	4.7119	4.7224	4.7728	4.7823	4.8275	4.8275	4.8360	4.8100	4.7823	4.7630	4.7430	
util living area													
	0.9984	0.9960	0.9883	0.9582	0.8695	0.7010	0.5371	0.6068	0.8595	0.9797	0.9966	0.9988	(86)
MIT	19.5972	19.7699	20.0584	20.4438	20.7660	20.9419	20.9871	20.9775	20.8388	20.4121	19.9362	19.5721	(87)
Th 2	19.8795	19.8824	19.8852	19.8984	19.9008	19.9124	19.9124	19.9145	19.9079	19.9008	19.8958	19.8906	(88)
util rest of house													
	0.9978	0.9946	0.9840	0.9420	0.8209	0.6056	0.4117	0.4771	0.7879	0.9691	0.9952	0.9984	(89)
MIT 2	18.6057	18.7801	19.0684	19.4535	19.7456	19.8865	19.9092	19.9083	19.8185	19.4312	18.9570	18.5893	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	18.8169	18.9909	19.2793	19.6645	19.9630	20.1113	20.1388	20.1360	20.0358	19.6401	19.1656	18.7987	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8169	18.9909	19.2793	19.6645	19.9630	20.1113	20.1388	20.1360	20.0358	19.6401	19.1656	18.7987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9931	0.9809	0.9377	0.8240	0.6243	0.4386	0.5049	0.7978	0.9657	0.9939	0.9978	(94)
Useful gains	438.7365	520.7734	601.7077	669.5498	649.5325	490.3180	327.5031	341.8672	477.3841	486.9711	432.7086	412.3127	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1404.9208	1359.7651	1229.7000	1022.0057	782.5224	515.7675	331.1756	348.8604	558.0552	856.1199	1148.5026	1397.0370	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	718.8411	563.8024	467.2262	253.7683	98.9445	0.0000	0.0000	0.0000	0.0000	274.6467	515.3717	732.6349	(98)
Space heating												3625.2357	(98)
Space heating per m2											(98) / (4) =	46.8558	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	879.6926	692.5239	709.6672	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8795	0.9325	0.9046	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	773.6460	645.7489	641.9613	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.6919	960.5660	880.7340	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000   168.5131   234.2239   177.6469     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          580.3839 (104)
Cooled fraction                                                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000    42.1283    58.5560    44.4117     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          145.0960 (107)
Space cooling per m2                                                                                                                     1.8754 (108)
Energy for space heating                                                                                                                46.8558 (99)
Energy for space cooling                                                                                                                 1.8754 (108)
Total                                                                                                                                   48.7312 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                     56.0 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1105	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3610	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3339	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3506	0.3339	0.3339	0.3089	0.3089	0.2755	0.2838	0.2671	0.2755	0.2922	0.2922	0.3172	(22b)
Effective ac	0.5615	0.5557	0.5557	0.5477	0.5477	0.5379	0.5403	0.5357	0.5379	0.5427	0.5427	0.5503	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.5443	33.2030	33.2030	32.7221	32.7221	32.1393	32.2788	32.0040	32.1393	32.4224	32.4224	32.8782	(38)
Heat transfer coeff	91.5265	91.1851	91.1851	90.7043	90.7043	90.1215	90.2609	89.9862	90.1215	90.4046	90.4046	90.8604	(39)
Average = Sum(39)m / 12 =												90.6221	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1830	1.1786	1.1786	1.1723	1.1723	1.1648	1.1666	1.1631	1.1648	1.1685	1.1685	1.1744	(40)
HLP (average)												1.1713	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4111 (42)
Average daily hot water use (litres/day)	91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	22.3801	19.5737	20.1983	17.6094	16.8966	14.5805	13.5110	15.5041	15.6892	18.2843	19.9587	21.6739 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6645	13.2206	14.5938	14.0740	14.5074	13.9983	14.4393	14.4835	14.0396	14.5581	14.1453	14.6504 (61)

Total heat required for water heating calculated for each month

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429 (64)

Total per year (kWh/year) = Sum(64)m = 1610.4406 (64)

RHI water heating demand 1610 (64)

Heat gains from water heating, kWh/month

	53.2752	46.6936	48.4214	42.5527	41.0811	35.8197	33.5592	37.9882	38.2877	44.1697	47.7782	51.7064 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	144.6639	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	47.7980	42.4538	34.5257	26.1382	19.5386	16.4953	17.8238	23.1680	31.0960	39.4836	46.0832	49.1265 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	319.1884	322.5005	314.1540	296.3851	273.9551	252.8740	238.7906	235.4784	243.8250	261.5939	284.0239	305.1049 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775	51.8775 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426	-96.4426 (71)

Water heating gains (Table 5)

	71.6065	69.4845	65.0826	59.1009	55.2165	49.7496	45.1065	51.0594	53.1773	59.3678	66.3586	69.4978 (72)

Total internal gains

	541.6916	537.5376	516.8610	484.7229	451.8089	422.2177	404.8195	412.8046	431.1971	463.5440	499.5643	526.8279 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.0400	11.9814	0.4600	0.0000	0.7700	4.4136	(74)
Northeast	0.8200	12.9236	0.4600	0.0000	0.7700	3.7536	(75)
Southeast	2.6100	40.4699	0.4600	0.0000	0.7700	37.4129	(77)
Southwest	3.4000	40.4699	0.4600	0.0000	0.7700	48.7371	(79)
West	1.0400	22.3313	0.4600	0.0000	0.7700	8.2261	(80)
Northwest	2.8100	12.9236	0.4600	0.0000	0.7700	12.8628	(81)
Northwest	4.5100	12.9236	0.4600	0.0000	0.7700	20.6446	(81)

Solar gains	136.0508	222.7525	337.7502	493.2729	592.1190	653.9502	613.4651	533.7015	418.5258	273.6201	169.9090	113.4466 (83)
Total gains	677.7424	760.2900	854.6112	977.9958	1043.9279	1076.1679	1018.2846	946.5060	849.7229	737.1641	669.4734	640.2745 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.7134	60.9407	60.9407	61.2637	61.2637	61.6599	61.5647	61.7526	61.6599	61.4669	61.4669	61.1585	
alpha	5.0476	5.0627	5.0627	5.0842	5.0842	5.1107	5.1043	5.1168	5.1107	5.0978	5.0978	5.0772	
util living area	0.9886	0.9790	0.9473	0.8475	0.6577	0.4159	0.2745	0.3037	0.5943	0.8893	0.9748	0.9910	(86)
MIT	20.0773	20.2240	20.4937	20.7905	20.9540	20.9964	20.9997	20.9995	20.9791	20.7712	20.3843	20.0466	(87)
Th 2	19.9336	19.9372	19.9372	19.9422	19.9422	19.9483	19.9468	19.9497	19.9483	19.9453	19.9453	19.9406	(88)
util rest of house	0.9848	0.9721	0.9302	0.8046	0.5840	0.3299	0.1814	0.2043	0.4960	0.8455	0.9649	0.9879	(89)
MIT 2	18.7457	18.9584	19.3374	19.7284	19.9076	19.9468	19.9468	19.9496	19.9371	19.7190	19.1966	18.7067	(90)
Living area fraction									fLA = Living area / (4) =			0.2130	(91)
MIT	19.0294	19.2280	19.5837	19.9546	20.1305	20.1704	20.1710	20.1732	20.1590	19.9431	19.4496	18.9921	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8794	19.0780	19.4337	19.8046	19.9805	20.0204	20.0210	20.0232	20.0090	19.7931	19.2996	18.8421	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9794	0.9645	0.9200	0.7982	0.5868	0.3358	0.1880	0.2113	0.5019	0.8380	0.9567	0.9833	(94)
Useful gains	663.7732	733.3321	786.2739	780.6742	612.5741	361.3991	191.4156	200.0028	426.4809	617.7418	640.5070	629.5854	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1261.1773	1228.9910	1097.2904	898.3912	633.1615	362.3220	191.4463	200.0583	433.3974	740.6963	1021.5329	1248.6114	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	444.4686	333.0828	231.3963	84.7563	15.3171	0.0000	0.0000	0.0000	0.0000	91.4781	274.3386	460.5553	(98)

Space heating 1935.3931 (98)

RHI space heating demand 1935 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3610	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3339	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4257	0.4174	0.4090	0.3673	0.3589	0.3172	0.3172	0.3089	0.3339	0.3589	0.3756	0.3923	(22b)
Effective ac	0.5906	0.5871	0.5837	0.5674	0.5644	0.5503	0.5503	0.5477	0.5557	0.5644	0.5706	0.5770	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.2865	35.0763	34.8702	33.9023	33.7213	32.8782	32.8782	32.7221	33.2030	33.7213	34.0876	34.4706	(38)
Heat transfer coeff	93.2687	93.0585	92.8524	91.8845	91.7034	90.8604	90.8604	90.7043	91.1851	91.7034	92.0698	92.4528	(39)
Average = Sum(39)m / 12 =												91.8836	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2055	1.2028	1.2001	1.1876	1.1853	1.1744	1.1744	1.1723	1.1786	1.1853	1.1900	1.1949	(40)
HLP (average)												1.1876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4111 (42)
Average daily hot water use (litres/day)		91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
              22.3801    19.5737    20.1983    17.6094    16.8966    14.5805    13.5110    15.5041    15.6892    18.2843    19.9587    21.6739 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6645    13.2206    14.5938    14.0740    14.5074    13.9983    14.4393    14.4835    14.0396    14.5581    14.1453    14.6504 (61)
Total heat required for water heating calculated for each month
              163.8648   143.7122   149.2494   131.4700   127.1517   111.2018   104.5126   117.8439   118.6344   136.4533   147.2035   159.1429 (62)
Solar input    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              163.8648   143.7122   149.2494   131.4700   127.1517   111.2018   104.5126   117.8439   118.6344   136.4533   147.2035   159.1429 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1610.4406 (64)
Heat gains from water heating, kWh/month
              53.2752    46.6936    48.4214    42.5527    41.0811    35.8197    33.5592    37.9882    38.2877    44.1697    47.7782    51.7064 (65)


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5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              47.7980    42.4538    34.5257    26.1382    19.5386    16.4953    17.8238    23.1680    31.0960    39.4836    46.0832    49.1265 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              319.1884   322.5005   314.1540   296.3851   273.9551   252.8740   238.7906   235.4784   243.8250   261.5939   284.0239   305.1049 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426 (71)
Water heating gains (Table 5)
              71.6065    69.4845    65.0826    59.1009    55.2165    49.7496    45.1065    51.0594    53.1773    59.3678    66.3586    69.4978 (72)
Total internal gains
              541.6916   537.5376   516.8610   484.7229   451.8089   422.2177   404.8195   412.8046   431.1971   463.5440   499.5643   526.8279 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a       Specific data    Specific data       factor                W
                                                          W/m2         or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------
North                                   1.0400           10.6334           0.4600           0.0000           0.7700            3.9170 (74)
Northeast                               0.8200           11.2829           0.4600           0.0000           0.7700            3.2771 (75)
Southeast                               2.6100           36.7938           0.4600           0.0000           0.7700           34.0145 (77)
Southwest                               3.4000           36.7938           0.4600           0.0000           0.7700           44.3101 (79)
West                                    1.0400           19.6403           0.4600           0.0000           0.7700            7.2348 (80)
Northwest                               2.8100           11.2829           0.4600           0.0000           0.7700           11.2299 (81)
Northwest                               4.5100           11.2829           0.4600           0.0000           0.7700           18.0238 (81)
-------------------------------------------------------------------------------------------------------------------

Solar gains    122.0073   221.2717   337.8757   476.5362   585.8934   604.3991   573.2548   488.3175   385.4315   254.0800   148.6001   102.8108 (83)
Total gains    663.6989   758.8092   854.7367   961.2592  1037.7023  1026.6168   978.0743   901.1221   816.6286   717.6240   648.1645   629.6388 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           59.5793    59.7139    59.8464    60.4768    60.5963    61.1585    61.1585    61.2637    60.9407    60.5963    60.3551    60.1051
alpha          4.9720     4.9809     4.9898     5.0318     5.0398     5.0772     5.0772     5.0842     5.0627     5.0398     5.0237     5.0070
util living area
               0.9917     0.9830     0.9595     0.8885     0.7434     0.5523     0.4062     0.4580     0.7110     0.9280     0.9835     0.9935 (86)

MIT           19.9474    20.1191    20.3835    20.6975    20.9044    20.9829    20.9970    20.9947    20.9429    20.6621    20.2463    19.9123 (87)
Th 2          19.9156    19.9178    19.9199    19.9299    19.9318    19.9406    19.9406    19.9422    19.9372    19.9318    19.9280    19.9240 (88)
util rest of house
               0.9890     0.9776     0.9465     0.8555     0.6807     0.4671     0.3098     0.3553     0.6237     0.8985     0.9772     0.9914 (89)
MIT 2         18.5442    18.7932    19.1701    19.6012    19.8484    19.9306    19.9396    19.9403    19.8977    19.5688    18.9867    18.4995 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2130 (91)
MIT           18.8431    19.0757    19.4285    19.8347    20.0733    20.1548    20.1648    20.1649    20.1203    19.8017    19.2550    18.8004 (92)
Temperature adjustment                                                                                                        -0.1500
adjusted MIT  18.6931    18.9257    19.2785    19.6847    19.9233    20.0048    20.0148    20.0149    19.9703    19.6517    19.1050    18.6504 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9845     0.9708     0.9367     0.8466     0.6802     0.4724     0.3166     0.3625     0.6266     0.8888     0.9705     0.9876 (94)
Useful gains 653.4357   736.6271   800.6275   813.8367   705.8460   484.9500   309.6509   326.6616   511.7346   637.8135   629.0399   621.8542 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
            1342.4218  1305.2067  1186.5176   990.9502   754.1077   491.0801   310.2743   327.8860   535.2857   830.0715  1105.2956  1335.9793 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              512.6057   382.0855   287.1023   127.5217    35.9067     0.0000     0.0000     0.0000     0.0000   143.0400   342.9042   531.3091 (98)
Space heating                                                                                                              2362.4751 (98)
Space heating per m2                                                                                                 (98) / (4) =     30.5348 (99)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2610.4697	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	512.6057	382.0855	287.1023	127.5217	35.9067	0.0000	0.0000	0.0000	0.0000	143.0400	342.9042	531.3091	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	566.4151	422.1939	317.2401	140.9080	39.6759	0.0000	0.0000	0.0000	0.0000	158.0552	378.8996	587.0818	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7035	89.6023	89.3794	88.8468	87.9851	87.3000	87.3000	87.3000	87.3000	88.9089	89.5145	89.7418	(217)
Fuel for water heating, kWh/month													
	182.6738	160.3889	166.9841	147.9738	144.5151	127.3789	119.7166	134.9873	135.8928	153.4754	164.4465	177.3342	(219)
Water heating fuel used												1815.7675	(219)
Annual totals kWh/year													
Space heating fuel - main system												2610.4697	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Total delivered energy for all uses												4838.8882	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2610.4697	3.4800	90.8443	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1815.7675	3.4800	63.1887	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	337.6510	13.1900	44.5362	(250)
Additional standing charges			120.0000	(251)
Total energy cost			328.4617	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1274	(257)
SAP value		84.2735	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2610.4697	0.2160	563.8615	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1815.7675	0.2160	392.2058	(264)
Space and water heating			956.0672	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Total kg/year			1170.2331	(272)
CO2 emissions per m2			15.1300	(273)
EI value			87.1855	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8857 = 3.929, stars = 4
Water heating environmental impact	0.216 / 0.8857 = 0.2439, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.3700 (1b)	x	2.3400 (2b)	=	181.0458	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.0458	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1105	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3610	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3339	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3506	0.3339	0.3339	0.3089	0.3089	0.2755	0.2838	0.2671	0.2755	0.2922	0.2922	0.3172	(22b)
Effective ac	0.5615	0.5557	0.5557	0.5477	0.5477	0.5379	0.5403	0.5357	0.5379	0.5427	0.5427	0.5503	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			11.7200	1.2357	14.4829			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.50			77.3700	0.1200	9.2844	75.0000	5802.7500	(28a)
EW Brick AAC015	86.5000	18.3600	68.1400	0.2500	17.0350	52.3000	3563.7220	(29a)
Bay	1.0400		1.0400	0.1400	0.1456	9.0000	9.3600	(30)
Ceiling to void	10.8400		10.8400	0.0800	0.8672	9.0000	97.5600	(30)
Total net area of external elements Aum(A, m2)			175.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1573			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			76.3300			70.0000	5343.1000	(32b)
GF Masonry			52.2500			75.0000	3918.7500	(32c)
GF Timber			77.0600			9.0000	693.5400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20004.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		258.5599 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8249 (36)
Total fabric heat loss	(33) + (36) =	57.9822 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.5443	33.2030	33.2030	32.7221	32.7221	32.1393	32.2788	32.0040	32.1393	32.4224	32.4224	32.8782	(38)
Heat transfer coeff	91.5265	91.1851	91.1851	90.7043	90.7043	90.1215	90.2609	89.9862	90.1215	90.4046	90.4046	90.8604	(39)
Average = Sum(39)m / 12 =												90.6221	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1830	1.1786	1.1786	1.1723	1.1723	1.1648	1.1666	1.1631	1.1648	1.1685	1.1685	1.1744	(40)
HLP (average)												1.1713	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4111 (42)
Average daily hot water use (litres/day)	91.4628 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.6091	96.9506	93.2920	89.6335	85.9750	82.3165	82.3165	85.9750	89.6335	93.2920	96.9506	100.6091	(44)
Energy conte	149.2003	130.4916	134.6556	117.3960	112.6443	97.2034	90.0733	103.3604	104.5949	121.8952	133.0582	144.4926	(45)
Energy content (annual)										Total = Sum(45)m =		1439.0658	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
              22.3801    19.5737    20.1983    17.6094    16.8966    14.5805    13.5110    15.5041    15.6892    18.2843    19.9587    21.6739 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6645    13.2206    14.5938    14.0740    14.5074    13.9983    14.4393    14.4835    14.0396    14.5581    14.1453    14.6504 (61)
Total heat required for water heating calculated for each month
             163.8648   143.7122   149.2494   131.4700   127.1517   111.2018   104.5126   117.8439   118.6344   136.4533   147.2035   159.1429 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
             163.8648   143.7122   149.2494   131.4700   127.1517   111.2018   104.5126   117.8439   118.6344   136.4533   147.2035   159.1429 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1610.4406 (64)
Heat gains from water heating, kWh/month
              53.2752    46.6936    48.4214    42.5527    41.0811    35.8197    33.5592    37.9882    38.2877    44.1697    47.7782    51.7064 (65)


-------------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639   144.6639 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              47.7980    42.4538    34.5257    26.1382    19.5386    16.4953    17.8238    23.1680    31.0960    39.4836    46.0832    49.1265 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             319.1884   322.5005   314.1540   296.3851   273.9551   252.8740   238.7906   235.4784   243.8250   261.5939   284.0239   305.1049 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775    51.8775 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426   -96.4426 (71)
Water heating gains (Table 5)
              71.6065    69.4845    65.0826    59.1009    55.2165    49.7496    45.1065    51.0594    53.1773    59.3678    66.3586    69.4978 (72)
Total internal gains
             541.6916   537.5376   516.8610   484.7229   451.8089   422.2177   404.8195   412.8046   431.1971   463.5440   499.5643   526.8279 (73)


-------------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------------

[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                           m2           Table 6a      Specific data    Specific data        factor                W
                                                           W/m2    or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------
North                                    1.0400           11.9814           0.4600           0.0000           0.7700            4.4136 (74)
Northeast                                0.8200           12.9236           0.4600           0.0000           0.7700            3.7536 (75)
Southeast                                2.6100           40.4699           0.4600           0.0000           0.7700           37.4129 (77)
Southwest                                3.4000           40.4699           0.4600           0.0000           0.7700           48.7371 (79)
West                                     1.0400           22.3313           0.4600           0.0000           0.7700            8.2261 (80)
Northwest                                2.8100           12.9236           0.4600           0.0000           0.7700           12.8628 (81)
Northwest                                4.5100           12.9236           0.4600           0.0000           0.7700           20.6446 (81)
-------------------------------------------------------------------------------------------------------------------

Solar gains    136.0508   222.7525   337.7502   493.2729   592.1190   653.9502   613.4651   533.7015   418.5258   273.6201   169.9090   113.4466 (83)
Total gains    677.7424   760.2900   854.6112   977.9958  1043.9279  1076.1679  1018.2846   946.5060   849.7229   737.1641   669.4734   640.2745 (84)


-------------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          60.7134    60.9407    60.9407    61.2637    61.2637    61.6599    61.5647    61.7526    61.6599    61.4669    61.4669    61.1585
alpha         5.0476     5.0627     5.0627     5.0842     5.0842     5.1107     5.1043     5.1168     5.1107     5.0978     5.0978     5.0772
util living area
               0.9886     0.9790     0.9473     0.8475     0.6577     0.4159     0.2745     0.3037     0.5943     0.8893     0.9748     0.9910 (86)

MIT           20.0773    20.2240    20.4937    20.7905    20.9540    20.9964    20.9997    20.9995    20.9791    20.7712    20.3843    20.0466 (87)
Th 2          19.9336    19.9372    19.9372    19.9422    19.9422    19.9483    19.9468    19.9497    19.9483    19.9453    19.9453    19.9406 (88)
util rest of house
               0.9848     0.9721     0.9302     0.8046     0.5840     0.3299     0.1814     0.2043     0.4960     0.8455     0.9649     0.9879 (89)
MIT 2         18.7457    18.9584    19.3374    19.7284    19.9076    19.9468    19.9468    19.9496    19.9371    19.7190    19.1966    18.7067 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.2130 (91)
MIT           19.0294    19.2280    19.5837    19.9546    20.1305    20.1704    20.1710    20.1732    20.1590    19.9431    19.4496    18.9921 (92)
Temperature adjustment                                                                                                        -0.1500
adjusted MIT  18.8794    19.0780    19.4337    19.8046    19.9805    20.0204    20.0210    20.0232    20.0090    19.7931    19.2996    18.8421 (93)


-------------------------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------------------------
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9794     0.9645     0.9200     0.7982     0.5868     0.3358     0.1880     0.2113     0.5019     0.8380     0.9567     0.9833 (94)
Useful gains 663.7732   733.3321   786.2739   780.6742   612.5741   361.3991   191.4156   200.0028   426.4809   617.7418   640.5070   629.5854 (95)
Ext temp.      5.1000     5.6000     7.4000     9.9000    13.0000    16.0000    17.9000    17.8000    15.2000    11.6000     8.0000     5.1000 (96)
Heat loss rate W
            1261.1773  1228.9910  1097.2904   898.3912   633.1615   362.3220   191.4463   200.0583   433.3974   740.6963  1021.5329  1248.6114 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             444.4686   333.0828   231.3963    84.7563    15.3171     0.0000     0.0000     0.0000     0.0000    91.4781   274.3386   460.5553 (98)
Space heating                                                                                                            1935.3931 (98)
Space heating per m2                                                                                    (98) / (4) =     25.0148 (99)
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2138.5559	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	444.4686	333.0828	231.3963	84.7563	15.3171	0.0000	0.0000	0.0000	0.0000	91.4781	274.3386	460.5553	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	491.1256	368.0472	255.6865	93.6533	16.9249	0.0000	0.0000	0.0000	0.0000	101.0808	303.1366	508.9009	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	163.8648	143.7122	149.2494	131.4700	127.1517	111.2018	104.5126	117.8439	118.6344	136.4533	147.2035	159.1429	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6152	89.5111	89.2177	88.5270	87.6331	87.3000	87.3000	87.3000	87.3000	88.5567	89.3562	89.6560	(217)
Fuel for water heating, kWh/month	182.8539	160.5524	167.2867	148.5084	145.0955	127.3789	119.7166	134.9873	135.8928	154.0858	164.7378	177.5039	(219)
Water heating fuel used												1818.6000	(219)
Annual totals kWh/year													
Space heating fuel - main system												2138.5559	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												337.6510	(232)
Total delivered energy for all uses												4369.8069	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2138.5559	3.9200	83.8314	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1818.6000	3.9200	71.2891	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	337.6510	16.9600	57.2656	(250)
Additional standing charges			88.0000	(251)
Total energy cost			313.1061	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2138.5559	0.2160	461.9281	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1818.6000	0.2160	392.8176	(264)
Space and water heating			854.7457	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	337.6510	0.5190	175.2409	(268)
Total kg/year			1068.9115	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2138.5559	1.2200	2609.0382	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1818.6000	1.2200	2218.6920	(264)
Space and water heating			4827.7302	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	337.6510	3.0700	1036.5886	(268)
Primary energy kWh/year			6094.5688	(272)
Primary energy kWh/m2/year			78.7717	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 84
Current environmental impact rating: B 87

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Not applicable
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Not applicable
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures: SAP change Cost change CO2 change
(none)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 84
Potential environmental impact rating: B 87

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£70	£70	£0
Mains gas	£243	£243	£0
Space heating	£185	£185	£0
Water heating	£71	£71	£0
Lighting	£57	£57	£0
Total cost of fuels	£313	£313	£0
Total cost of uses	£313	£313	£0
Delivered energy	56 kWh/m²	56 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	14 kg/m²	14 kg/m²	0 kg/m²
Primary energy	79 kWh/m²	79 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached Maisonette
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	258.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	3.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		179.24 (P1)
Transmission heat loss coefficient		57.98 (37)
Summer heat loss coefficient		237.22 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.0400	81.1852	0.4600	0.0000	0.9000	34.9551
North East	0.8200	98.8453	0.4600	0.0000	0.9000	33.5560
South East	2.6100	119.9223	0.4600	0.0000	0.9000	129.5809
South West	3.4000	119.9223	0.4600	0.0000	0.9000	168.8027
West	1.0400	117.5071	0.4600	0.0000	0.9000	50.5938
North West	2.8100	98.8453	0.4600	0.0000	0.9000	114.9907
North West	4.5100	98.8453	0.4600	0.0000	0.9000	184.5580
total:						717.0371

	Jun	Jul	Aug	
Solar gains	764	717	624	(P4)
Internal gains	419	402	410	
Total summer gains	1184	1119	1034	(P5)
Summer gain/loss ratio	4.99	4.72	4.36	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 258.6)	0.19	0.19	0.19	
Threshold temperature	21.18	22.81	22.35	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-342	**Issued on Date**	19/10/2022
Assessment Reference	Plot 342	**Prop Type Ref**	FF-2BMW-As-DET
Property	Plot 342, 2 Bed, K, B		

SAP Rating	83 B	**DER**	18.93	**TER**	20.62
Environmental	86 B	**% DER<TER**	8.22		
CO_2 Emissions (t/year)	1.15	**DFEE**	52.79	**TFEE**	61.69
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.43		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached Maisonette, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 20.62 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.93 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)61.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.8 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.29 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.90 m², No overhang
Windows facing South East: 4.31 m², No overhang
Windows facing South West: 0.82 m², No overhang
Windows facing North West: 2.22 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
External wall U-value 0.08 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400 (1b)	x	2.7200 (2b)	=	13.4368	(1b) - (3b)
First floor	68.8700 (1c)	x	2.3100 (2c)	=	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1159	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3664	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3389	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4322	0.4237	0.4152	0.3728	0.3644	0.3220	0.3220	0.3135	0.3389	0.3644	0.3813	0.3983	(22b)
Effective ac	0.5934	0.5898	0.5862	0.5695	0.5664	0.5518	0.5518	0.5491	0.5574	0.5664	0.5727	0.5793	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108	(36)
Total fabric heat loss	(33) + (36) =	62.6141	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.7832	33.5768	33.3744	32.4240	32.2461	31.4183	31.4183	31.2650	31.7372	32.2461	32.6059	32.9820	(38)
Heat transfer coeff	96.3973	96.1909	95.9885	95.0381	94.8603	94.0325	94.0325	93.8792	94.3513	94.8603	95.2200	95.5961	(39)
Average = Sum(39)m / 12 =												95.0372	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3060	1.3032	1.3005	1.2876	1.2852	1.2740	1.2740	1.2719	1.2783	1.2852	1.2901	1.2952	(40)
HLP (average)												1.2876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3350	(42)
Average daily hot water use (litres/day)	89.6553	(43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
								Total per year (kWh/year) = Sum(64)m =				1581.8514	(64)
Heat gains from water heating, kWh/month	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains	356.3565	354.2863	341.4283	320.7574	299.8453	279.6684	266.5558	272.3804	282.9996	303.8752	327.8321	345.7282	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.4600	0.0000	0.7700	19.5824	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.8200	36.7938	0.4600	0.0000	0.7700	10.6865	(79)
Northwest	2.2200	11.2829	0.4600	0.0000	0.7700	8.8720	(81)

Solar gains	95.3106	171.8006	260.1698	364.4423	446.6138	460.2785	436.7269	372.8405	295.8724	196.6451	115.8813	80.4523	(83)
Total gains	451.6671	526.0869	601.5981	685.1997	746.4591	739.9470	703.2827	645.2209	578.8720	500.5204	443.7134	426.1805	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.3574	49.4634	49.5676	50.0633	50.1572	50.5987	50.5987	50.6814	50.4277	50.1572	49.9677	49.7711	
alpha	4.2905	4.2976	4.3045	4.3376	4.3438	4.3732	4.3732	4.3788	4.3618	4.3438	4.3312	4.3181	
util living area	0.9969	0.9936	0.9845	0.9543	0.8739	0.7216	0.5630	0.6262	0.8579	0.9734	0.9941	0.9976	(86)
MIT	19.4816	19.6558	19.9519	20.3482	20.6978	20.9106	20.9766	20.9633	20.7968	20.3436	19.8410	19.4506	(87)
Th 2	19.8361	19.8383	19.8405	19.8506	19.8524	19.8613	19.8613	19.8629	19.8579	19.8524	19.8486	19.8446	(88)
util rest of house	0.9959	0.9915	0.9791	0.9375	0.8270	0.6256	0.4295	0.4911	0.7868	0.9606	0.9918	0.9968	(89)
MIT 2	17.8265	18.0819	18.5128	19.0840	19.5520	19.7998	19.8523	19.8470	19.6886	19.0882	18.3600	17.7869	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.1960	18.4333	18.8341	19.3663	19.8078	20.0478	20.1033	20.0963	19.9360	19.3685	18.6907	18.1583	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0460	18.2833	18.6841	19.2163	19.6578	19.8978	19.9533	19.9463	19.7860	19.2185	18.5407	18.0083	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9935	0.9873	0.9714	0.9253	0.8174	0.6290	0.4408	0.5018	0.7813	0.9504	0.9878	0.9949	(94)
Useful gains	448.7174	519.3803	584.3868	634.0249	610.1547	465.4070	310.0416	323.7711	452.2827	475.6821	438.2926	423.9866	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1325.0820	1287.3550	1169.5377	980.4369	754.8807	498.1670	315.3231	332.9214	536.4828	817.5563	1089.3839	1320.0226	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	652.0153	516.0790	435.3523	249.4167	107.6761	0.0000	0.0000	0.0000	0.0000	254.3544	468.7857	666.6508	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating			3350.3303 (98)
Space heating per m2		(98) / (4) =	45.3913 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3702.0225 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	652.0153	516.0790	435.3523	249.4167	107.6761	0.0000	0.0000	0.0000	0.0000	254.3544	468.7857	666.6508	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	720.4588	570.2530	481.0523	275.5985	118.9791	0.0000	0.0000	0.0000	0.0000	281.0546	517.9953	736.6307	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8481	89.7932	89.6721	89.3823	88.7528	87.3000	87.3000	87.3000	87.3000	89.3695	89.7248	89.8744	(217)
Fuel for water heating, kWh/month													
	179.0816	157.1595	163.4551	144.4779	140.7440	125.1678	117.6677	132.6356	133.5125	149.9741	161.1135	173.8794	(219)
Water heating fuel used												1778.8688	(219)
Annual totals kWh/year													
Space heating fuel - main system												3702.0225	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Total delivered energy for all uses												5891.9157	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3702.0225	0.2160	799.6369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1778.8688	0.2160	384.2357	(264)
Space and water heating			1183.8725	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Total CO2, kg/year			1397.1942	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.9300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.9300	ZC1
Total Floor Area	TFA	73.8100	
Assumed number of occupants	N	2.3350	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5403	ZC2
CO2 emissions from cooking, equation (L16)		2.3715	ZC3
Total CO2 emissions		37.8418	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		37.8418	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1739	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4239	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3921	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4999	0.4901	0.4803	0.4313	0.4215	0.3725	0.3725	0.3627	0.3921	0.4215	0.4411	0.4607	(22b)
Effective ac	0.6250	0.6201	0.6154	0.5930	0.5888	0.5694	0.5694	0.5658	0.5769	0.5888	0.5973	0.6061	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
GF B&B J150 P/A=1+			4.9400	0.1300	0.6422			(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.1800	13.3236			(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.1800	0.0180			(29a)
Wall to Void	15.3500		15.3500	0.1800	2.7630			(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.1300	0.4979			(30)
Plane	68.5000		68.5000	0.1300	8.9050			(30)
Sloping	10.5200		10.5200	0.1300	1.3676			(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8878			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.2530	(36)
Total fabric heat loss (33) + (36) =	61.1408	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.5813	35.3051	35.0343	33.7624	33.5244	32.4166	32.4166	32.2115	32.8433	33.5244	34.0058	34.5091	(38)
Heat transfer coeff	96.7222	96.4459	96.1751	94.9032	94.6652	93.5574	93.5574	93.3523	93.9842	94.6652	95.1466	95.6499	(39)
Average = Sum(39)m / 12 =												94.9021	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3104	1.3067	1.3030	1.2858	1.2826	1.2675	1.2675	1.2648	1.2733	1.2826	1.2891	1.2959	(40)
HLP (average)												1.2858	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3350 (42)
Average daily hot water use (litres/day)	89.6553 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.2561	43.7420	46.6011	43.3293	42.9461	39.7922	41.1186	42.9461	43.3293	46.6011	46.8664	50.2561 (61)

Total heat required for water heating calculated for each month

	196.5080	171.6548	178.5957	158.4054	153.3644	135.0748	129.4119	144.2640	145.8572	166.0875	177.2951	191.8932 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	196.5080	171.6548	178.5957	158.4054	153.3644	135.0748	129.4119	144.2640	145.8572	166.0875	177.2951	191.8932 (64)

Total per year (kWh/year) = Sum(64)m = 1948.4118 (64)

Heat gains from water heating, kWh/month

	61.1928	53.4665	55.5385	49.0951	47.4506	41.6295	39.6372	44.4247	44.9228	51.3795	55.0841	59.6584 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)

Water heating gains (Table 5)

	82.2484	79.5633	74.6485	68.1877	63.7777	57.8187	53.2758	59.7106	62.3928	69.0585	76.5058	80.1860	(72)

Total internal gains

	368.3211	365.6465	352.1884	330.9198	309.4051	288.6279	275.5236	281.9480	293.1734	314.6469	339.1988	357.6973	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.6300	0.7000	0.7700	16.8962	(75)
Southeast	4.3100	36.7938	0.6300	0.7000	0.7700	48.4645	(77)
Southwest	0.8200	36.7938	0.6300	0.7000	0.7700	9.2206	(79)
Northwest	2.2200	11.2829	0.6300	0.7000	0.7700	7.6550	(81)

Solar gains	82.2365	148.2340	224.4813	314.4503	385.3500	397.1403	376.8194	321.6965	255.2865	169.6706	99.9854	69.4163	(83)
Total gains	450.5575	513.8805	576.6697	645.3701	694.7552	685.7682	652.3429	603.6444	548.4599	484.3174	439.1842	427.1136	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9940	53.1458	53.2954	54.0097	54.1455	54.7866	54.7866	54.9070	54.5379	54.1455	53.8715	53.5881	
alpha	4.5329	4.5431	4.5530	4.6006	4.6097	4.6524	4.6524	4.6605	4.6359	4.6097	4.5914	4.5725	
util living area													
	0.9978	0.9956	0.9894	0.9678	0.9037	0.7631	0.6015	0.6622	0.8839	0.9803	0.9958	0.9983	(86)
MIT	19.5589	19.7120	19.9800	20.3497	20.6863	20.9060	20.9760	20.9630	20.7963	20.3667	19.9015	19.5368	(87)
Th 2	19.8327	19.8356	19.8385	19.8520	19.8545	19.8663	19.8663	19.8685	19.8618	19.8545	19.8494	19.8441	(88)
util rest of house													
	0.9970	0.9940	0.9854	0.9545	0.8621	0.6671	0.4610	0.5223	0.8173	0.9698	0.9940	0.9977	(89)
MIT 2	17.9257	18.1511	18.5429	19.0821	19.5397	19.8021	19.8575	19.8530	19.6918	19.1150	18.4380	17.9012	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.2904	18.4996	18.8637	19.3651	19.7957	20.0486	20.1073	20.1009	19.9384	19.3945	18.7648	18.2664	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2904	18.4996	18.8637	19.3651	19.7957	20.0486	20.1073	20.1009	19.9384	19.3945	18.7648	18.2664	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9913	0.9806	0.9471	0.8595	0.6843	0.4926	0.5534	0.8228	0.9638	0.9914	0.9964	(94)
Useful gains	448.4972	509.4286	565.4576	611.2122	597.1717	469.2644	321.3219	334.0327	451.2492	466.8046	435.4023	425.5762	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.1800	1311.6287	1189.0839	993.1704	766.3846	509.7529	328.1295	345.4856	548.7163	832.5338	1109.8629	1345.4472	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	673.0840	539.0785	463.9780	275.0099	125.8944	0.0000	0.0000	0.0000	0.0000	272.1025	485.6116	684.3840	(98)
Space heating												3519.1429	(98)
Space heating per m2											(98) / (4) =	47.6784	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3767.8190	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	673.0840	539.0785	463.9780	275.0099	125.8944	0.0000	0.0000	0.0000	0.0000	272.1025	485.6116	684.3840	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	720.6467	577.1718	496.7644	294.4432	134.7906	0.0000	0.0000	0.0000	0.0000	291.3303	519.9268	732.7452	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.5080	171.6548	178.5957	158.4054	153.3644	135.0748	129.4119	144.2640	145.8572	166.0875	177.2951	191.8932	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9016	87.7348	87.3465	86.4270	84.5590	80.3000	80.3000	80.3000	80.3000	86.2864	87.4580	87.9768	(217)
Fuel for water heating, kWh/month													
	223.5546	195.6519	204.4681	183.2823	181.3695	168.2127	161.1605	179.6562	181.6403	192.4840	202.7204	218.1180	(219)
Water heating fuel used												2292.3185	(219)
Annual totals kWh/year													
Space heating fuel - main system												3767.8190	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Total delivered energy for all uses												6471.1619	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3767.8190	0.2160	813.8489	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2292.3185	0.2160	495.1408	(264)
Space and water heating			1308.9897	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Total CO2, kg/m2/year			1522.3114	(272)
Emissions per m2 for space and water heating			17.7346	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3628	(272b)
Emissions per m2 for pumps and fans			0.5274	(272c)
Target Carbon Dioxide Emission Rate (TER) = (17.7346 * 1.00) + 2.3628 + 0.5274, rounded to 2 d.p.			20.6200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400 (1b)	x	2.7200 (2b)	=	13.4368	(1b) - (3b)
First floor	68.8700 (1c)	x	2.3100 (2c)	=	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1739	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4244	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3926	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5005	0.4907	0.4809	0.4318	0.4220	0.3729	0.3729	0.3631	0.3926	0.4220	0.4416	0.4613	(22b)
Effective ac	0.6253	0.6204	0.6156	0.5932	0.5890	0.5695	0.5695	0.5659	0.5771	0.5890	0.5975	0.6064	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			30.0000	2066.1000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			9.0000	44.4600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14329.2660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		194.1372 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.5981	35.3212	35.0498	33.7749	33.5363	32.4259	32.4259	32.2203	32.8537	33.5363	34.0189	34.5234	(38)
Heat transfer coeff	98.2122	97.9353	97.6639	96.3890	96.1505	95.0401	95.0401	94.8344	95.4678	96.1505	96.6330	97.1375	(39)
Average = Sum(39)m / 12 =												96.3878	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3306	1.3269	1.3232	1.3059	1.3027	1.2876	1.2876	1.2848	1.2934	1.3027	1.3092	1.3160	(40)
HLP (average)												1.3059	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3350 (42)
Average daily hot water use (litres/day)	89.6553 (43)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	31.0785	27.1815	28.0488	24.4537	23.4639	20.2475	18.7623	21.5300	21.7872	25.3909	27.7161	30.0979	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0271	16.8997	13.7438	10.4049	7.7778	6.5663	7.0952	9.2226	12.3785	15.7173	18.3445	19.5559	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	206.0212	208.1591	202.7718	191.3028	176.8252	163.2184	154.1282	151.9904	157.3777	168.8467	183.3242	196.9310	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	34.6748	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	41.7722	40.4486	37.7001	33.9634	31.5375	28.1216	25.2182	28.9382	30.2600	34.1275	38.4946	40.4542	(72)
Total internal gains													
	324.8449	323.5318	312.2400	293.6955	274.1649	255.9307	244.4660	248.1755	258.0406	276.7159	298.1877	314.9655	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.4600	0.0000	0.7700	19.5824	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.8200	36.7938	0.4600	0.0000	0.7700	10.6865	(79)
Northwest	2.2200	11.2829	0.4600	0.0000	0.7700	8.8720	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	95.3106	171.8006	260.1698	364.4423	446.6138	460.2785	436.7269	372.8405	295.8724	196.6451	115.8813	80.4523	(83)
Total gains	420.1555	495.3324	572.4098	658.1378	720.7787	716.2093	681.1929	621.0160	553.9130	473.3611	414.0690	395.4178	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.5281	40.6427	40.7556	41.2947	41.3971	41.8808	41.8808	41.9716	41.6931	41.3971	41.1904	40.9765	
alpha	3.7019	3.7095	3.7170	3.7530	3.7598	3.7921	3.7921	3.7981	3.7795	3.7598	3.7460	3.7318	
util living area													
	0.9952	0.9906	0.9792	0.9455	0.8656	0.7224	0.5727	0.6355	0.8532	0.9674	0.9915	0.9962	(86)
MIT	19.1841	19.3848	19.7265	20.1873	20.5960	20.8637	20.9579	20.9376	20.7212	20.1897	19.6078	19.1546	(87)
Th 2	19.8169	19.8199	19.8227	19.8362	19.8387	19.8505	19.8505	19.8527	19.8460	19.8387	19.8336	19.8283	(88)
util rest of house													
	0.9938	0.9880	0.9730	0.9282	0.8211	0.6315	0.4409	0.5043	0.7869	0.9539	0.9887	0.9951	(89)
MIT 2	18.1728	18.3746	18.7151	19.1741	19.5536	19.7805	19.8376	19.8313	19.6772	19.1858	18.6079	18.1519	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.3986	18.6001	18.9409	19.4003	19.7864	20.0223	20.0877	20.0783	19.9103	19.4100	18.8311	18.3758	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3986	18.6001	18.9409	19.4003	19.7864	20.0223	20.0877	20.0783	19.9103	19.4100	18.8311	18.3758	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9915	0.9842	0.9668	0.9201	0.8187	0.6465	0.4698	0.5323	0.7913	0.9472	0.9853	0.9932	(94)
Useful gains	416.6021	487.5081	553.4119	605.5706	590.1277	463.0539	320.0292	330.5844	438.3307	448.3752	407.9758	392.7320	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1384.6563	1341.7272	1215.0255	1012.1144	777.5069	515.3390	331.4753	348.8307	554.6986	847.0809	1133.6148	1376.9994	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	720.2323	574.0352	492.2405	292.7116	139.4101	0.0000	0.0000	0.0000	0.0000	296.6371	522.4601	732.2950	(98)
Space heating												3770.0219	(98)
Space heating per m2											(98) / (4) =	51.0774	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	893.3765	703.2964	720.7416	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8045	0.8702	0.8362	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	718.7364	611.9745	602.7180	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	924.1788	881.5022	812.6774	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	147.9186	200.5286	156.2098	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												504.6569	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	36.9796	50.1321	39.0524	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												126.1642	(107)
Space cooling per m2												1.7093	(108)
Energy for space heating												51.0774	(99)
Energy for space cooling												1.7093	(108)
Total												52.7867	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1739	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4239	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3921	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4999	0.4901	0.4803	0.4313	0.4215	0.3725	0.3725	0.3627	0.3921	0.4215	0.4411	0.4607	(22b)
Effective ac	0.6250	0.6201	0.6154	0.5930	0.5888	0.5694	0.5694	0.5658	0.5769	0.5888	0.5973	0.6061	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
GF B&B J150 P/A=1+			4.9400	0.1300	0.6422			(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.1800	13.3236			(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.1800	0.0180			(29a)
Wall to Void	15.3500		15.3500	0.1800	2.7630			(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.1300	0.4979			(30)
Plane	68.5000		68.5000	0.1300	8.9050			(30)
Sloping	10.5200		10.5200	0.1300	1.3676			(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8878			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.2530	(36)
Total fabric heat loss					(33) + (36) =		61.1408	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.5813	35.3051	35.0343	33.7624	33.5244	32.4166	32.4166	32.2115	32.8433	33.5244	34.0058	34.5091	(38)
Heat transfer coeff	96.7222	96.4459	96.1751	94.9032	94.6652	93.5574	93.5574	93.3523	93.9842	94.6652	95.1466	95.6499	(39)
Average = Sum(39)m / 12 =												94.9021	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3104	1.3067	1.3030	1.2858	1.2826	1.2675	1.2675	1.2648	1.2733	1.2826	1.2891	1.2959	(40)
HLP (average)												1.2858	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3350	(42)
Average daily hot water use (litres/day)	89.6553	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Primary loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (59)
Heat gains from water heating, kWh/month
31.0785 27.1815 28.0488 24.4537 23.4639 20.2475 18.7623 21.5300 21.7872 25.3909 27.7161 30.0979 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	116.7480	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
19.0271 16.8997 13.7438 10.4049 7.7778 6.5663 7.0952 9.2226 12.3785 15.7173 18.3445 19.5559 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
206.0212 208.1591 202.7718 191.3028 176.8252 163.2184 154.1282 151.9904 157.3777 168.8467 183.3242 196.9310 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 34.6748 (69)
Pumps, fans 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 -93.3984 (71)
Water heating gains (Table 5)
41.7722 40.4486 37.7001 33.9634 31.5375 28.1216 25.2182 28.9382 30.2600 34.1275 38.4946 40.4542 (72)
Total internal gains
324.8449 323.5318 312.2400 293.6955 274.1649 255.9307 244.4660 248.1755 258.0406 276.7159 298.1877 314.9655 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.6300	0.7000	0.7700	16.8962	(75)
Southeast	4.3100	36.7938	0.6300	0.7000	0.7700	48.4645	(77)
Southwest	0.8200	36.7938	0.6300	0.7000	0.7700	9.2206	(79)
Northwest	2.2200	11.2829	0.6300	0.7000	0.7700	7.6550	(81)

Solar gains	82.2365	148.2340	224.4813	314.4503	385.3500	397.1403	376.8194	321.6965	255.2865	169.6706	99.9854	69.4163	(83)
Total gains	407.0814	471.7659	536.7213	608.1458	659.5149	653.0711	621.2853	569.8720	513.3270	446.3865	398.1731	384.3818	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9940	53.1458	53.2954	54.0097	54.1455	54.7866	54.7866	54.9070	54.5379	54.1455	53.8715	53.5881	
alpha	4.5329	4.5431	4.5530	4.6006	4.6097	4.6524	4.6524	4.6605	4.6359	4.6097	4.5914	4.5725	
util living area	0.9986	0.9969	0.9920	0.9740	0.9174	0.7856	0.6261	0.6913	0.9037	0.9856	0.9972	0.9989	(86)
MIT	19.5056	19.6609	19.9328	20.3096	20.6579	20.8932	20.9717	20.9558	20.7703	20.3234	19.8515	19.4842	(87)
Th 2	19.8327	19.8356	19.8385	19.8520	19.8545	19.8663	19.8663	19.8685	19.8618	19.8545	19.8494	19.8441	(88)
util rest of house	0.9980	0.9958	0.9889	0.9629	0.8798	0.6918	0.4825	0.5498	0.8438	0.9776	0.9960	0.9985	(89)
MIT 2	18.4776	18.6347	18.9075	19.2885	19.6163	19.8153	19.8591	19.8555	19.7269	19.3082	18.8362	18.4651	(90)
Living area fraction										fLA = Living area / (4) =		0.2233	(91)
MIT	18.7072	18.8639	19.1364	19.5165	19.8489	20.0560	20.1075	20.1012	19.9599	19.5349	19.0629	18.6926	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7072	18.8639	19.1364	19.5165	19.8489	20.0560	20.1075	20.1012	19.9599	19.5349	19.0629	18.6926	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9944	0.9863	0.9587	0.8796	0.7094	0.5150	0.5817	0.8502	0.9745	0.9948	0.9979	(94)
Useful gains	405.9909	469.1471	529.3881	583.0318	580.0909	463.3150	319.9872	331.4786	436.4367	434.9949	396.0842	383.5932	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1393.4914	1346.7565	1215.3090	1007.5412	771.4176	510.4500	328.1543	345.5133	550.7363	845.8243	1138.2255	1386.2193	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	734.7003	589.7535	510.3252	305.6468	142.3471	0.0000	0.0000	0.0000	0.0000	305.6570	534.3417	745.9538	(98)
Space heating												3868.7255	(98)
Space heating per m2											(98) / (4) =	52.4147	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	879.4400	692.3251	709.4775	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8090	0.8816	0.8469	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	711.4498	610.3632	600.8372	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	850.3809	811.4804	752.8987	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	100.0304	149.6312	113.1338	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												362.7954 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	25.0076	37.4078	28.2834	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												90.6988 (107)
Space cooling per m2												1.2288 (108)
Energy for space heating												52.4147 (99)
Energy for space cooling												1.2288 (108)
Total												53.6435 (109)
Target Fabric Energy Efficiency (TFEE)												61.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3664	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3389	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3559	0.3389	0.3389	0.3135	0.3135	0.2796	0.2881	0.2712	0.2796	0.2966	0.2966	0.3220	(22b)
Effective ac	0.5633	0.5574	0.5574	0.5491	0.5491	0.5391	0.5415	0.5368	0.5391	0.5440	0.5440	0.5518	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.0724	31.7372	31.7372	31.2650	31.2650	30.6927	30.8297	30.5599	30.6927	30.9707	30.9707	31.4183	(38)
Heat transfer coeff	94.6865	94.3513	94.3513	93.8792	93.8792	93.3069	93.4438	93.1740	93.3069	93.5848	93.5848	94.0325	(39)
Average = Sum(39)m / 12 =												93.7984	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2828	1.2783	1.2783	1.2719	1.2719	1.2641	1.2660	1.2623	1.2641	1.2679	1.2679	1.2740	(40)
HLP (average)												1.2708	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
									Total per year (kWh/year) = Sum(64)m =			1581.8514	(64)
RHI water heating demand												1582	(64)
Heat gains from water heating, kWh/month													
	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	47.5677	42.2492	34.3594	26.0123	19.4445	16.4158	17.7379	23.0564	30.9462	39.2934	45.8612	48.8898	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	307.4944	310.6852	302.6444	285.5265	263.9183	243.6096	230.0421	226.8513	234.8921	252.0099	273.6182	293.9269	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains													
	526.3899	522.1815	501.9361	470.6080	438.6246	409.9286	393.1320	401.0947	419.1012	450.6341	485.6623	512.0775	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	12.9236	0.4600	0.0000	0.7700	22.4299	(75)
Southeast	4.3100	40.4699	0.4600	0.0000	0.7700	61.7815	(77)
Southwest	0.8200	40.4699	0.4600	0.0000	0.7700	11.7542	(79)
Northwest	2.2200	12.9236	0.4600	0.0000	0.7700	10.1621	(81)

Solar gains	106.1277	172.6935	259.7364	376.9243	451.1486	497.8554	467.1827	407.2178	320.9134	211.4613	132.3037	88.6498	(83)
Total gains	632.5175	694.8750	761.6726	847.5323	889.7732	907.7840	860.3147	808.3125	740.0146	662.0954	617.9660	600.7273	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.2492	50.4277	50.4277	50.6814	50.6814	50.9922	50.9175	51.0649	50.9922	50.8408	50.8408	50.5987	
alpha	4.3499	4.3618	4.3618	4.3788	4.3788	4.3995	4.3945	4.4043	4.3995	4.3894	4.3894	4.3732	
util living area													
	0.9865	0.9787	0.9555	0.8874	0.7393	0.5002	0.3348	0.3660	0.6705	0.9093	0.9742	0.9888	(86)
MIT	19.8406	19.9826	20.2689	20.6179	20.8772	20.9835	20.9979	20.9969	20.9406	20.6338	20.1894	19.8129	(87)
Th 2	19.8543	19.8579	19.8579	19.8629	19.8629	19.8690	19.8676	19.8704	19.8690	19.8661	19.8661	19.8613	(88)
util rest of house													
	0.9823	0.9721	0.9412	0.8518	0.6651	0.3935	0.2135	0.2383	0.5637	0.8718	0.9646	0.9853	(89)
MIT 2	18.3601	18.5666	18.9739	19.4511	19.7616	19.8617	19.8672	19.8699	19.8333	19.4867	18.8725	18.3251	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.6907	18.8828	19.2630	19.7116	20.0107	20.1122	20.1197	20.1216	20.0805	19.7428	19.1665	18.6573	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5407	18.7328	19.1130	19.5616	19.8607	19.9622	19.9697	19.9716	19.9305	19.5928	19.0165	18.5073	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9754	0.9631	0.9291	0.8406	0.6649	0.4026	0.2246	0.2499	0.5701	0.8605	0.9548	0.9791	(94)
Useful gains	616.9483	669.2371	707.6481	712.4353	591.6515	365.4550	193.1867	201.9923	421.8521	569.7179	590.0131	588.2007	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1272.6496	1239.0936	1105.1400	907.0243	644.0745	369.6986	193.3992	202.3326	441.3919	748.0094	1030.9772	1260.7204	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	487.8418	382.9436	295.7340	140.1041	39.0027	0.0000	0.0000	0.0000	0.0000	132.6489	317.4941	500.3547 (98)
Space heating												2296.1239 (98)
RHI space heating demand												2296 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3664	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3389	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4322	0.4237	0.4152	0.3728	0.3644	0.3220	0.3220	0.3135	0.3389	0.3644	0.3813	0.3983	(22b)
Effective ac	0.5934	0.5898	0.5862	0.5695	0.5664	0.5518	0.5518	0.5491	0.5574	0.5664	0.5727	0.5793	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.7832	33.5768	33.3744	32.4240	32.2461	31.4183	31.4183	31.2650	31.7372	32.2461	32.6059	32.9820	(38)
Heat transfer coeff	96.3973	96.1909	95.9885	95.0381	94.8603	94.0325	94.0325	93.8792	94.3513	94.8603	95.2200	95.5961	(39)
Average = Sum(39)m / 12 =												95.0372	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3060	1.3032	1.3005	1.2876	1.2852	1.2740	1.2740	1.2719	1.2783	1.2852	1.2901	1.2952	(40)
HLP (average)												1.2876	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
								Total per year (kWh/year) = Sum(64)m =				1581.8514	(64)
Heat gains from water heating, kWh/month													
	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	47.5677	42.2492	34.3594	26.0123	19.4445	16.4158	17.7379	23.0564	30.9462	39.2934	45.8612	48.8898	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	307.4944	310.6852	302.6444	285.5265	263.9183	243.6096	230.0421	226.8513	234.8921	252.0099	273.6182	293.9269	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains													
	526.3899	522.1815	501.9361	470.6080	438.6246	409.9286	393.1320	401.0947	419.1012	450.6341	485.6623	512.0775	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	11.2829	0.4600	0.0000	0.7700	19.5824	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.8200	36.7938	0.4600	0.0000	0.7700	10.6865	(79)
Northwest	2.2200	11.2829	0.4600	0.0000	0.7700	8.8720	(81)

Solar gains	95.3106	171.8006	260.1698	364.4423	446.6138	460.2785	436.7269	372.8405	295.8724	196.6451	115.8813	80.4523	(83)
Total gains	621.7004	693.9821	762.1059	835.0503	885.2383	870.2072	829.8589	773.9351	714.9737	647.2792	601.5436	592.5297	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.3574	49.4634	49.5676	50.0633	50.1572	50.5987	50.5987	50.6814	50.4277	50.1572	49.9677	49.7711	
alpha	4.2905	4.2976	4.3045	4.3376	4.3438	4.3732	4.3732	4.3788	4.3618	4.3438	4.3312	4.3181	
util living area													
	0.9896	0.9822	0.9647	0.9165	0.8115	0.6423	0.4864	0.5379	0.7735	0.9384	0.9818	0.9914	(86)
MIT	19.6976	19.8641	20.1393	20.4946	20.7846	20.9435	20.9867	20.9796	20.8710	20.5016	20.0373	19.6635	(87)
Th 2	19.8361	19.8383	19.8405	19.8506	19.8524	19.8613	19.8613	19.8629	19.8579	19.8524	19.8486	19.8446	(88)
util rest of house													
	0.9864	0.9769	0.9537	0.8900	0.7542	0.5467	0.3665	0.4145	0.6884	0.9130	0.9753	0.9888	(89)
MIT 2	18.1400	18.3818	18.7774	19.2779	19.6490	19.8247	19.8565	19.8547	19.7594	19.3003	18.6420	18.0964	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.4877	18.7128	19.0814	19.5496	19.9025	20.0745	20.1088	20.1058	20.0076	19.5685	18.9536	18.4463	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3377	18.5628	18.9314	19.3996	19.7525	19.9245	19.9588	19.9558	19.8576	19.4185	18.8036	18.2963	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9805	0.9686	0.9422	0.8772	0.7485	0.5524	0.3771	0.4251	0.6883	0.9005	0.9669	0.9837	(94)
Useful gains	609.5572	672.1836	718.0531	732.4997	662.6412	480.6934	312.9581	328.9879	492.1519	582.8585	581.6386	582.8512	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1353.2002	1314.2354	1193.2757	997.8609	763.8649	500.6723	315.8362	333.8187	543.2348	836.5298	1114.4144	1347.5545	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	553.2704	431.4588	353.5656	191.0600	75.3105	0.0000	0.0000	0.0000	0.0000	188.7314	383.5986	568.9392	(98)

Space heating			2745.9346 (98)
Space heating per m2		(98) / (4) =	37.2027 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)			0.0000 (201)
Fraction of space heat from main system(s)			1.0000 (202)
Efficiency of main space heating system 1 (in %)			90.5000 (206)
Efficiency of secondary/supplementary heating system, %			0.0000 (208)
Space heating requirement			3034.1819 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	553.2704	431.4588	353.5656	191.0600	75.3105	0.0000	0.0000	0.0000	0.0000	188.7314	383.5986	568.9392	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	611.3485	476.7500	390.6803	211.1161	83.2160	0.0000	0.0000	0.0000	0.0000	208.5430	423.8659	628.6621	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7587	89.6897	89.5381	89.1816	88.4767	87.3000	87.3000	87.3000	87.3000	89.1431	89.6011	89.7908	(217)
Fuel for water heating, kWh/month	179.2600	157.3408	163.6996	144.8031	141.1833	125.1678	117.6677	132.6356	133.5125	150.3550	161.3361	174.0414	(219)
Water heating fuel used												1781.0028	(219)
Annual totals kWh/year													
Space heating fuel - main system												3034.1819	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Total delivered energy for all uses												5226.2092	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3034.1819	3.4800	105.5895	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1781.0028	3.4800	61.9789	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	336.0245	13.1900	44.3216	(250)
Additional standing charges			120.0000	(251)
Total energy cost			341.7826	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =		1.2082 (257)
SAP value			83.1453
SAP rating (Section 12)			83 (258)
SAP band			B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3034.1819	0.2160	655.3833	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1781.0028	0.2160	384.6966	(264)
Space and water heating			1040.0799	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Total kg/year			1253.4016	(272)
CO2 emissions per m2			16.9800	(273)
EI value			85.8635	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water heating energy efficiency	3.48 / 0.8870 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	4.9400	(1b)	x 2.7200	(2b) =	13.4368	(1b) - (3b)
First floor	68.8700	(1c)	x 2.3100	(2c) =	159.0897	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.5265	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1159	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3664	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3389	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3559	0.3389	0.3389	0.3135	0.3135	0.2796	0.2881	0.2712	0.2796	0.2966	0.2966	0.3220	(22b)
Effective ac	0.5633	0.5574	0.5574	0.5491	0.5491	0.5391	0.5415	0.5368	0.5391	0.5440	0.5440	0.5518	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			12.2500	1.2357	15.1378			(27)
GF B&B J150 P/A=1+			4.9400	0.1400	0.6916	75.0000	370.5000	(28a)
EW Brick AAC015	86.5000	12.4800	74.0200	0.2500	18.5050	52.3000	3871.2460	(29a)
Dormer Cheek	2.0000	1.9000	0.1000	0.4400	0.0440	9.0000	0.9000	(29a)
Wall to Void	15.3500		15.3500	0.0800	1.2280	9.0000	138.1500	(29a)
PR 400mm MW044 Dormer	3.8300		3.8300	0.2900	1.1107	9.0000	34.4700	(30)
Plane	68.5000		68.5000	0.1600	10.9600	9.0000	616.5000	(30)
Sloping	10.5200		10.5200	0.1100	1.1572	9.0000	94.6800	(30)
Total net area of external elements Aum(A, m2)			191.6400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.6033			(33)
E-WM-30			12.8000	0.0000	0.0000	45.0000	576.0000	(32)
E-FC-4			68.8700			70.0000	4820.9000	(32d)
E-FC-4			68.8700			70.0000	4820.9000	(32b)
Masonry			6.7000			75.0000	502.5000	(32c)
Timber			122.6600			9.0000	1103.9400	(32c)
Internal Floor			4.9400			18.0000	88.9200	(32d)
Internal Ceiling			4.9400			18.0000	88.9200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17128.5260 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		232.0624 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0108 (36)
Total fabric heat loss	(33) + (36) =	62.6141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.0724	31.7372	31.7372	31.2650	31.2650	30.6927	30.8297	30.5599	30.6927	30.9707	30.9707	31.4183	(38)
Heat transfer coeff	94.6865	94.3513	94.3513	93.8792	93.8792	93.3069	93.4438	93.1740	93.3069	93.5848	93.5848	94.0325	(39)
Average = Sum(39)m / 12 =												93.7984	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2828	1.2783	1.2783	1.2719	1.2719	1.2641	1.2660	1.2623	1.2641	1.2679	1.2679	1.2740	(40)
HLP (average)												1.2708	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3350 (42)
Average daily hot water use (litres/day)		89.6553 (43)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	98.6209	95.0346	91.4484	87.8622	84.2760	80.6898	80.6898	84.2760	87.8622	91.4484	95.0346	98.6209	(44)
Energy conte	146.2519	127.9128	131.9946	115.0761	110.4182	95.2825	88.2933	101.3178	102.5279	119.4864	130.4287	141.6371	(45)
Energy content (annual)										Total = Sum(45)m =		1410.6273	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.9378	19.1869	19.7992	17.2614	16.5627	14.2924	13.2440	15.1977	15.3792	17.9230	19.5643	21.2456	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6496	13.2058	14.5790	14.0616	14.4961	13.9889	14.4306	14.4731	14.0285	14.5447	14.1302	14.6360	(61)
Total heat required for water heating calculated for each month													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
									Total per year (kWh/year) = Sum(64)m =			1581.8514	(64)
Heat gains from water heating, kWh/month													
	52.2912	45.8325	47.5330	41.7782	40.3381	35.1787	32.9652	37.3064	37.5977	43.3654	46.9001	50.7533	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	140.0976	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	47.5677	42.2492	34.3594	26.0123	19.4445	16.4158	17.7379	23.0564	30.9462	39.2934	45.8612	48.8898	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	307.4944	310.6852	302.6444	285.5265	263.9183	243.6096	230.0421	226.8513	234.8921	252.0099	273.6182	293.9269	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	51.3447	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	-93.3984	(71)
Water heating gains (Table 5)													
	70.2838	68.2031	63.8884	58.0253	54.2178	48.8593	44.3080	50.1431	52.2190	58.2868	65.1390	68.2168	(72)
Total internal gains													
	526.3899	522.1815	501.9361	470.6080	438.6246	409.9286	393.1320	401.0947	419.1012	450.6341	485.6623	512.0775	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9000	12.9236	0.4600	0.0000	0.7700	22.4299	(75)
Southeast	4.3100	40.4699	0.4600	0.0000	0.7700	61.7815	(77)
Southwest	0.8200	40.4699	0.4600	0.0000	0.7700	11.7542	(79)
Northwest	2.2200	12.9236	0.4600	0.0000	0.7700	10.1621	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	106.1277	172.6935	259.7364	376.9243	451.1486	497.8554	467.1827	407.2178	320.9134	211.4613	132.3037	88.6498	(83)
Total gains	632.5175	694.8750	761.6726	847.5323	889.7732	907.7840	860.3147	808.3125	740.0146	662.0954	617.9660	600.7273	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	50.2492	50.4277	50.4277	50.6814	50.6814	50.9922	50.9175	51.0649	50.9922	50.8408	50.8408	50.5987	
alpha	4.3499	4.3618	4.3618	4.3788	4.3788	4.3995	4.3945	4.4043	4.3995	4.3894	4.3894	4.3732	
util living area													
	0.9865	0.9787	0.9555	0.8874	0.7393	0.5002	0.3348	0.3660	0.6705	0.9093	0.9742	0.9888	(86)
MIT	19.8406	19.9826	20.2689	20.6179	20.8772	20.9835	20.9979	20.9969	20.9406	20.6338	20.1894	19.8129	(87)
Th 2	19.8543	19.8579	19.8579	19.8629	19.8629	19.8690	19.8676	19.8704	19.8690	19.8661	19.8661	19.8613	(88)
util rest of house													
	0.9823	0.9721	0.9412	0.8518	0.6651	0.3935	0.2135	0.2383	0.5637	0.8718	0.9646	0.9853	(89)
MIT 2	18.3601	18.5666	18.9739	19.4511	19.7616	19.8617	19.8672	19.8699	19.8333	19.4867	18.8725	18.3251	(90)
Living area fraction									fLA = Living area / (4) =			0.2233	(91)
MIT	18.6907	18.8828	19.2630	19.7116	20.0107	20.1122	20.1197	20.1216	20.0805	19.7428	19.1665	18.6573	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5407	18.7328	19.1130	19.5616	19.8607	19.9622	19.9697	19.9716	19.9305	19.5928	19.0165	18.5073	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9754	0.9631	0.9291	0.8406	0.6649	0.4026	0.2246	0.2499	0.5701	0.8605	0.9548	0.9791	(94)
Useful gains	616.9483	669.2371	707.6481	712.4353	591.6515	365.4550	193.1867	201.9923	421.8521	569.7179	590.0131	588.2007	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1272.6496	1239.0936	1105.1400	907.0243	644.0745	369.6986	193.3992	202.3326	441.3919	748.0094	1030.9772	1260.7204	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	487.8418	382.9436	295.7340	140.1041	39.0027	0.0000	0.0000	0.0000	0.0000	132.6489	317.4941	500.3547	(98)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating		2296.1239 (98)
Space heating per m2	(98) / (4) =	31.1086 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2537.1534 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	487.8418	382.9436	295.7340	140.1041	39.0027	0.0000	0.0000	0.0000	0.0000	132.6489	317.4941	500.3547	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	539.0517	423.1421	326.7779	154.8112	43.0969	0.0000	0.0000	0.0000	0.0000	146.5733	350.8222	552.8781	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	160.9015	141.1186	146.5736	129.1377	124.9143	109.2715	102.7239	115.7909	116.5564	134.0311	144.5589	156.2731	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6847	89.6155	89.4139	88.9364	88.0407	87.3000	87.3000	87.3000	87.3000	88.8629	89.4739	89.7173	(217)
Fuel for water heating, kWh/month													
	179.4080	157.4713	163.9271	145.2023	141.8824	125.1678	117.6677	132.6356	133.5125	150.8290	161.5654	174.1838	(219)
Water heating fuel used												1783.4530	(219)
Annual totals kWh/year													
Space heating fuel - main system												2537.1534	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												336.0245	(232)
Total delivered energy for all uses												4731.6309	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2537.1534	3.9200	99.4564	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1783.4530	3.9200	69.9114	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	336.0245	16.9600	56.9898	(250)
Additional standing charges			88.0000	(251)
Total energy cost			327.0775	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2537.1534	0.2160	548.0251	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1783.4530	0.2160	385.2259	(264)
Space and water heating			933.2510	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.0245	0.5190	174.3967	(268)
Total kg/year			1146.5727	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2537.1534	1.2200	3095.3272	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1783.4530	1.2200	2175.8127	(264)
Space and water heating			5271.1399	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	336.0245	3.0700	1031.5951	(268)
Primary energy kWh/year			6532.9850	(272)
Primary energy kWh/m2/year			88.5108	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 83
Current environmental impact rating: B 86

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Not applicable
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Not applicable
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 83
Potential environmental impact rating: B 86

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£70	£70	£0
Mains gas	£257	£257	£0
Space heating	£200	£200	£0
Water heating	£70	£70	£0
Lighting	£57	£57	£0
Total cost of fuels	£327	£327	£0
Total cost of uses	£327	£327	£0
Delivered energy	64 kWh/m²	64 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	16 kg/m²	16 kg/m²	0 kg/m²
Primary energy	89 kWh/m²	89 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached Maisonette
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	232.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	227.73 (P1)
Transmission heat loss coefficient	62.61 (37)
Summer heat loss coefficient	290.35 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.9000	98.8453	0.4600	0.0000	0.9000	200.5175
South East	4.3100	119.9223	0.4600	0.0000	0.9000	213.9822
South West	0.8200	119.9223	0.4600	0.0000	0.9000	40.7112
North West	2.2200	98.8453	0.4600	0.0000	0.9000	90.8467
total:						546.0577

	Jun	Jul	Aug	
Solar gains	582	546	476	(P4)
Internal gains	407	390	398	
Total summer gains	989	936	874	(P5)
Summer gain/loss ratio	3.41	3.22	3.01	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 232.1)	0.38	0.38	0.38	
Threshold temperature	19.78	21.50	21.19	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-343	**Issued on Date**	19/10/2022
Assessment Reference	Plot 343	**Prop Type Ref**	2-As-SEMI
Property	Plot 343, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	16.94	**TER**	18.61
Environmental	87 B	**% DER<TER**	8.96		
CO_2 Emissions (t/year)	1.14	**DFEE**	46.13	**TFEE**	53.68
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.07		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.61 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.94 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.1 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.63 m², No overhang
Windows facing South West: 9.19 m², No overhang
Windows facing North West: 2.47 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045	(83)
Total gains	519.7752	627.1702	728.5554	830.8917	900.8059	889.6994	848.4470	783.5275	709.1919	606.1500	519.4706	486.7343	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9832	0.9692	0.9411	0.8785	0.7682	0.6139	0.4743	0.5250	0.7433	0.9150	0.9722	0.9862	(86)
MIT	19.0380	19.3092	19.7166	20.2199	20.6267	20.8741	20.9594	20.9433	20.7541	20.2096	19.5323	18.9931	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9797	0.9628	0.9287	0.8525	0.7187	0.5332	0.3684	0.4173	0.6720	0.8911	0.9654	0.9833	(89)
MIT 2	17.2813	17.6748	18.2605	18.9738	19.5135	19.8143	19.8939	19.8850	19.6891	18.9777	18.0101	17.2229	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7213	18.0842	18.6253	19.2859	19.7923	20.0798	20.1609	20.1501	19.9559	19.2863	18.3914	17.6663	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5713	17.9342	18.4753	19.1359	19.6423	19.9298	20.0109	20.0001	19.8059	19.1363	18.2414	17.5163	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9688	0.9471	0.9079	0.8305	0.7053	0.5344	0.3782	0.4260	0.6642	0.8694	0.9506	0.9739	(94)
Useful gains	503.5421	593.9970	661.4239	690.0876	635.3342	475.4390	320.8578	333.8023	471.0149	526.9927	493.7922	474.0116	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1329.2713	1301.7585	1192.6111	1005.7847	778.4400	516.2098	330.3546	347.9107	555.1793	836.6569	1097.5917	1318.8542	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	614.3426	475.6157	395.2033	227.3019	106.4707	0.0000	0.0000	0.0000	0.0000	230.3901	434.7356	628.5629	(98)
Space heating												3112.6228	(98)
Space heating per m2											(98) / (4) =	38.7528	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3439.3622	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	614.3426	475.6157	395.2033	227.3019	106.4707	0.0000	0.0000	0.0000	0.0000	230.3901	434.7356	628.5629	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	678.8315	525.5422	436.6887	251.1623	117.6471	0.0000	0.0000	0.0000	0.0000	254.5747	480.3709	694.5447	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7994	89.7288	89.5909	89.2904	88.7193	87.3000	87.3000	87.3000	87.3000	89.2726	89.6602	89.8275	(217)
Fuel for water heating, kWh/month													
	184.9817	162.3599	168.8600	149.2240	145.2359	129.0595	121.2740	136.7748	137.7020	154.9126	166.4212	179.5882	(219)
Water heating fuel used												1836.3937	(219)
Annual totals kWh/year													
Space heating fuel - main system												3439.3622	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5701.8021	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3439.3622	0.2160	742.9022	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.3937	0.2160	396.6610	(264)
Space and water heating			1139.5633	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/year			1360.6812	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.9400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.9400	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.3983	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.3983	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)
Northwest	2.4700	11.2829	0.6300	0.7000	0.7700	8.5171	(81)

Solar gains	124.3727	218.8393	317.9834	425.1026	504.5423	513.3824	489.7582	428.5834	354.7787	246.8677	150.2421	105.6138	(83)
Total gains	512.1956	604.3065	689.3087	773.9966	830.6578	817.5247	780.0371	725.4638	663.4893	578.2217	507.5196	482.1419	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9974	0.9938	0.9836	0.9493	0.8578	0.6885	0.5225	0.5790	0.8263	0.9693	0.9944	0.9980	(86)
MIT	19.7004	19.8764	20.1507	20.5037	20.7925	20.9497	20.9895	20.9830	20.8742	20.4938	20.0328	19.6732	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9965	0.9916	0.9777	0.9306	0.8075	0.5948	0.4023	0.4554	0.7490	0.9543	0.9921	0.9974	(89)
MIT 2	18.1813	18.4398	18.8388	19.3471	19.7255	19.9042	19.9331	19.9322	19.8338	19.3441	18.6784	18.1494	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5619	18.7997	19.1674	19.6368	19.9928	20.1661	20.1977	20.1954	20.0944	19.6321	19.0177	18.5311	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5619	18.7997	19.1674	19.6368	19.9928	20.1661	20.1977	20.1954	20.0944	19.6321	19.0177	18.5311	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9886	0.9724	0.9244	0.8111	0.6163	0.4326	0.4865	0.7624	0.9489	0.9894	0.9961	(94)
Useful gains	509.5513	597.3965	670.2609	715.4782	673.7774	503.8218	337.4257	352.9150	505.8408	548.6742	502.1166	480.2521	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1397.5902	1358.0945	1234.1208	1031.7965	794.8698	527.0911	340.6903	358.6015	570.3183	865.7375	1148.3001	1388.3596	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	660.7010	511.1890	419.5118	227.7492	90.0927	0.0000	0.0000	0.0000	0.0000	235.8951	465.2522	675.6319	(98)
Space heating												3286.0229	(98)
Space heating per m2											(98) / (4) =	40.9116	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3518.2258	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	660.7010	511.1890	419.5118	227.7492	90.0927	0.0000	0.0000	0.0000	0.0000	235.8951	465.2522	675.6319	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	707.3886	547.3116	449.1561	243.8428	96.4590	0.0000	0.0000	0.0000	0.0000	252.5644	498.1287	723.3747	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8100	87.5586	87.0501	85.8777	83.6843	80.3000	80.3000	80.3000	80.3000	85.8471	87.2934	87.8980	(217)
Fuel for water heating, kWh/month													
	230.4978	203.0016	212.4439	190.9995	189.7681	174.1812	166.8789	186.0308	188.0853	200.3335	210.3091	224.8305	(219)
Water heating fuel used												2377.3604	(219)
Annual totals kWh/year													
Space heating fuel - main system												3518.2258	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6321.6324	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3518.2258	0.2160	759.9368	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.3604	0.2160	513.5099	(264)
Space and water heating			1273.4466	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1494.5646	(272)
Emissions per m2 for space and water heating			15.8547	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8547 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045	(83)
Total gains	487.4194	595.5955	698.6029	803.1417	874.4869	865.3924	825.8467	758.7366	683.6198	578.2989	489.0456	455.1540	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9860	0.9731	0.9468	0.8870	0.7793	0.6260	0.4853	0.5387	0.7577	0.9238	0.9764	0.9886	(86)
MIT	18.9865	19.2615	19.6757	20.1900	20.6088	20.8666	20.9566	20.9388	20.7384	20.1749	19.4855	18.9422	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9830	0.9675	0.9354	0.8622	0.7307	0.5451	0.3777	0.4294	0.6877	0.9018	0.9705	0.9862	(89)
MIT 2	18.0557	18.3294	18.7378	19.2410	19.6231	19.8417	19.8996	19.8933	19.7484	19.2398	18.5637	18.0197	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2889	18.5629	18.9728	19.4788	19.8700	20.0985	20.1644	20.1552	19.9964	19.4740	18.7946	18.2508	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2889	18.5629	18.9728	19.4788	19.8700	20.0985	20.1644	20.1552	19.9964	19.4740	18.7946	18.2508	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9587	0.9237	0.8510	0.7291	0.5597	0.4035	0.4548	0.6938	0.8910	0.9626	0.9812	(94)
Useful gains	476.2725	571.0078	645.2887	683.4798	637.5568	484.3629	333.2264	345.0869	474.3242	515.2908	470.7403	446.5942	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1401.1389	1364.5448	1242.1558	1039.4706	800.7534	532.5473	345.2265	362.9042	573.7200	869.7585	1152.0872	1391.5966	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.1006	533.2569	444.0691	256.3134	121.4183	0.0000	0.0000	0.0000	0.0000	263.7239	490.5697	703.0818	(98)
Space heating												3500.5337	(98)
Space heating per m2											(98) / (4) =	43.5823	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	910.4273	716.7194	734.4609	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8329	0.8875	0.8615	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	758.2687	636.0598	632.7435	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1103.6518	1055.5287	978.6572	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	248.6758	312.0849	257.3598	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												818.1206	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	62.1690	78.0212	64.3400	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												204.5301	(107)
Space cooling per m2												2.5464	(108)
Energy for space heating												43.5823	(99)
Energy for space cooling												2.5464	(108)
Total												46.1288	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)
Northwest	2.4700	11.2829	0.6300	0.7000	0.7700	8.5171	(81)

Solar gains	124.3727	218.8393	317.9834	425.1026	504.5423	513.3824	489.7582	428.5834	354.7787	246.8677	150.2421	105.6138	(83)
Total gains	467.6463	560.8040	648.0492	735.5580	794.2736	783.7738	747.9839	690.5996	627.2163	539.0513	465.1598	438.3633	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9982	0.9955	0.9872	0.9576	0.8740	0.7101	0.5428	0.6040	0.8491	0.9765	0.9962	0.9987	(86)
MIT	19.6495	19.8276	20.1065	20.4685	20.7712	20.9424	20.9876	20.9796	20.8560	20.4542	19.9850	19.6230	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9976	0.9939	0.9825	0.9414	0.8268	0.6163	0.4189	0.4771	0.7762	0.9645	0.9946	0.9983	(89)
MIT 2	18.6772	18.8568	19.1354	19.4975	19.7725	19.9109	19.9338	19.9333	19.8533	19.4915	19.0250	18.6595	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.9208	19.1000	19.3787	19.7407	20.0227	20.1693	20.1978	20.1954	20.1045	19.7327	19.2655	18.9008	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9208	19.1000	19.3787	19.7407	20.0227	20.1693	20.1978	20.1954	20.1045	19.7327	19.2655	18.9008	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9923	0.9795	0.9380	0.8317	0.6383	0.4503	0.5092	0.7897	0.9617	0.9932	0.9977	(94)
Useful gains	466.1754	556.4831	634.7657	689.9420	660.6124	500.3043	336.8056	351.6703	495.3358	518.4162	462.0011	437.3481	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1432.7620	1387.4383	1254.7024	1041.7820	797.7402	527.3910	340.6949	358.6001	571.2727	875.3769	1172.1750	1424.1766	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	719.1404	558.4018	461.2329	253.3248	102.0231	0.0000	0.0000	0.0000	0.0000	265.5788	511.3253	734.2004	(98)
Space heating												3605.2276	(98)
Space heating per m2											(98) / (4) =	44.8858	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8786	0.9333	0.9099	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	782.0495	654.0048	653.3519	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1008.2534	964.5203	899.0165	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	162.8668	231.0235	182.7744	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												576.6648	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	40.7167	57.7559	45.6936	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												144.1662 (107)
Space cooling per m2												1.7949 (108)
Energy for space heating												44.8858 (99)
Energy for space cooling												1.7949 (108)
Total												46.6807 (109)
Target Fabric Energy Efficiency (TFEE)												53.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
RHI water heating demand												1632	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast		3.6300	12.9236	0.4600	0.0000	0.7700	16.6164	(75)
Southwest		4.6800	40.4699	0.4600	0.0000	0.7700	67.0852	(79)
Northwest		2.4700	12.9236	0.4600	0.0000	0.7700	11.3065	(81)
Southwest		4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(79)

Solar gains	159.6564	253.2748	365.1052	505.8802	587.2368	640.3388	603.9261	538.8796	442.5495	305.4854	197.6762	134.2162	(83)
Total gains	715.1408	804.4602	894.9892	1002.6838	1050.1503	1072.8418	1018.6020	961.7454	884.3983	780.6265	709.8605	674.4461	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9546	0.9339	0.8879	0.7906	0.6382	0.4286	0.2886	0.3132	0.5696	0.8190	0.9257	0.9607	(86)
MIT	19.5158	19.7262	20.0987	20.5217	20.8241	20.9667	20.9936	20.9916	20.9108	20.5462	19.9840	19.4769	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9457	0.9213	0.8663	0.7519	0.5746	0.3433	0.1901	0.2106	0.4826	0.7757	0.9091	0.9529	(89)
MIT 2	17.9832	18.2845	18.8073	19.3814	19.7545	19.9056	19.9218	19.9248	19.8601	19.4322	18.6639	17.9340	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3671	18.6457	19.1308	19.6670	20.0224	20.1714	20.1903	20.1921	20.1233	19.7113	18.9946	18.3205	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2171	18.4957	18.9808	19.5170	19.8724	20.0214	20.0403	20.0421	19.9733	19.5613	18.8446	18.1705	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9002	0.8440	0.7356	0.5717	0.3512	0.2009	0.2217	0.4868	0.7588	0.8878	0.9356	(94)
Useful gains	663.0159	724.2006	755.4063	737.6201	600.4001	376.7287	204.6679	213.2596	430.5051	592.3164	630.2240	630.9921	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1282.4423	1254.7454	1126.8087	929.3866	664.1491	385.4059	205.5319	214.4618	457.4691	766.0991	1043.5533	1265.9265	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	460.8533	356.5260	276.3234	138.0719	47.4293	0.0000	0.0000	0.0000	0.0000	129.2943	297.5971	472.3912	(98)
Space heating												2178.4865	(98)
RHI space heating demand												2178	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	144.1457	253.6308	368.5370	492.6864	584.7555	595.0010	567.6210	496.7204	411.1822	286.1153	174.1279	122.4045	(83)
Total gains	699.6300	804.8162	898.4210	989.4900	1047.6691	1027.5040	982.2970	919.5862	853.0310	761.2564	686.3122	662.6344	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9628	0.9419	0.9040	0.8282	0.7081	0.5511	0.4172	0.4590	0.6665	0.8611	0.9430	0.9680	(86)
MIT	19.3126	19.5632	19.9308	20.3721	20.7114	20.9085	20.9721	20.9617	20.8246	20.3812	19.7737	19.2667	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9556	0.9310	0.8859	0.7960	0.6549	0.4733	0.3211	0.3605	0.5917	0.8275	0.9304	0.9618	(89)
MIT 2	17.6755	18.0350	18.5563	19.1711	19.6099	19.8440	19.9011	19.8963	19.7593	19.2014	18.3510	17.6168	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0856	18.4178	18.9006	19.4719	19.8859	20.1107	20.1694	20.1632	20.0262	19.4970	18.7074	18.0301	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9356	18.2678	18.7506	19.3219	19.7359	19.9607	20.0194	20.0132	19.8762	19.3470	18.5574	17.8801	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9383	0.9102	0.8630	0.7764	0.6459	0.4767	0.3306	0.3696	0.5891	0.8069	0.9100	0.9459	(94)
Useful gains	656.4570	732.5763	775.2946	768.1910	676.7294	489.8305	324.7689	339.8459	502.4796	614.2864	624.5758	626.7674	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1365.7515	1335.0716	1220.0337	1024.0622	787.6077	519.2015	331.1788	349.1780	562.0228	857.3032	1128.7218	1354.8857	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	527.7151	404.8769	330.8859	184.2273	82.4935	0.0000	0.0000	0.0000	0.0000	180.8045	362.9851	541.7200	(98)
Space heating												2615.7082	(98)
Space heating per m2											(98) / (4) =	32.5661	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2890.2853	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	527.7151	404.8769	330.8859	184.2273	82.4935	0.0000	0.0000	0.0000	0.0000	180.8045	362.9851	541.7200	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	583.1106	447.3777	365.6197	203.5661	91.1530	0.0000	0.0000	0.0000	0.0000	199.7840	401.0885	598.5857	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7127	89.6306	89.4710	89.1288	88.5217	87.3000	87.3000	87.3000	87.3000	89.0848	89.5438	89.7452	(217)
Fuel for water heating, kWh/month													
	185.1605	162.5377	169.0863	149.4946	145.5601	129.0595	121.2740	136.7748	137.7020	155.2390	166.6375	179.7530	(219)
Water heating fuel used												1838.2790	(219)
Annual totals kWh/year													
Space heating fuel - main system												2890.2853	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5154.6105	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2890.2853	3.4800	100.5819	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.2790	3.4800	63.9721	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Total energy cost			340.7495	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1420	(257)
SAP value		84.0692	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2890.2853	0.2160	624.3016	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.2790	0.2160	397.0683	(264)
Space and water heating			1021.3699	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1242.4878	(272)
CO2 emissions per m2			15.4700	(273)
EI value			86.7145	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8867 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8867 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	12.9236	0.4600	0.0000	0.7700	16.6164	(75)
Southwest	4.6800	40.4699	0.4600	0.0000	0.7700	67.0852	(79)
Northwest	2.4700	12.9236	0.4600	0.0000	0.7700	11.3065	(81)
Southwest	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(79)

Solar gains	159.6564	253.2748	365.1052	505.8802	587.2368	640.3388	603.9261	538.8796	442.5495	305.4854	197.6762	134.2162	(83)
Total gains	715.1408	804.4602	894.9892	1002.6838	1050.1503	1072.8418	1018.6020	961.7454	884.3983	780.6265	709.8605	674.4461	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9546	0.9339	0.8879	0.7906	0.6382	0.4286	0.2886	0.3132	0.5696	0.8190	0.9257	0.9607	(86)
MIT	19.5158	19.7262	20.0987	20.5217	20.8241	20.9667	20.9936	20.9916	20.9108	20.5462	19.9840	19.4769	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9457	0.9213	0.8663	0.7519	0.5746	0.3433	0.1901	0.2106	0.4826	0.7757	0.9091	0.9529	(89)
MIT 2	17.9832	18.2845	18.8073	19.3814	19.7545	19.9056	19.9218	19.9248	19.8601	19.4322	18.6639	17.9340	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3671	18.6457	19.1308	19.6670	20.0224	20.1714	20.1903	20.1921	20.1233	19.7113	18.9946	18.3205	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2171	18.4957	18.9808	19.5170	19.8724	20.0214	20.0403	20.0421	19.9733	19.5613	18.8446	18.1705	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9002	0.8440	0.7356	0.5717	0.3512	0.2009	0.2217	0.4868	0.7588	0.8878	0.9356	(94)
Useful gains	663.0159	724.2006	755.4063	737.6201	600.4001	376.7287	204.6679	213.2596	430.5051	592.3164	630.2240	630.9921	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1282.4423	1254.7454	1126.8087	929.3866	664.1491	385.4059	205.5319	214.4618	457.4691	766.0991	1043.5533	1265.9265	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	460.8533	356.5260	276.3234	138.0719	47.4293	0.0000	0.0000	0.0000	0.0000	129.2943	297.5971	472.3912	(98)
Space heating												2178.4865	(98)
Space heating per m2											(98) / (4) =	27.1226	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2407.1675	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	460.8533	356.5260	276.3234	138.0719	47.4293	0.0000	0.0000	0.0000	0.0000	129.2943	297.5971	472.3912	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	509.2301	393.9514	305.3297	152.5656	52.4080	0.0000	0.0000	0.0000	0.0000	142.8667	328.8366	521.9792	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6295	89.5478	89.3414	88.8997	88.1385	87.3000	87.3000	87.3000	87.3000	88.8174	89.4056	89.6633	(217)
Fuel for water heating, kWh/month													
	185.3322	162.6880	169.3316	149.8799	146.1930	129.0595	121.2740	136.7748	137.7020	155.7063	166.8952	179.9170	(219)
Water heating fuel used												1840.7536	(219)
Annual totals kWh/year													
Space heating fuel - main system												2407.1675	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												4673.9672	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2407.1675	3.9200	94.3610	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.7536	3.9200	72.1575	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Total energy cost			326.7759	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2407.1675	0.2160	519.9482	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7536	0.2160	397.6028	(264)
Space and water heating			917.5510	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1138.6689	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2407.1675	1.2200	2936.7443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7536	1.2200	2245.7194	(264)
Space and water heating			5182.4637	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Primary energy kWh/year			6490.4253	(272)
Primary energy kWh/m2/year			80.8071	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (16.0%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (99.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 89
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£72	£81	-£8
Mains gas	£255	£217	£38
Space heating	£195	£195	£0
Water heating	£72	£43	£29
Lighting	£60	£60	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£327	-£11	£339
Total cost of uses	£327	-£11	£338
Delivered energy	58 kWh/m²	24 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	81 kWh/m²	-2 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                                  Total = Sum(45)m =   1460.6794 (45)
Distribution loss  (46)m = 0.15 x (45)m
               22.7162    19.8677    20.5017    17.8739    17.1504    14.7995    13.7139    15.7369    15.9249    18.5589    20.2585    21.9994 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6712    13.2321    14.6052    14.0835    14.5162    14.0056    14.4461    14.4916    14.0481    14.5684    14.1570    14.6569 (61)
Total heat required for water heating calculated for each month
              166.1124   145.6836   151.2832   133.2428   128.8524   112.6690   105.8722   119.4044   120.2139   138.2944   149.2136   161.3196 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1079.5246 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1813.6014 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.2416 (H8)
Utilisation factor                                                                                                                    0.5531 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               92.8365 (H14)
Volume ratio Veff/V                                                                                                                   0.8079 (H15)
Solar storage volume factor                                                                                                           0.9573 (H16)
Solar input                                                                                                                        -844.3736 (H17)
Solar input    -24.4852   -40.8587   -69.5870   -93.2603  -115.2152  -113.2749  -111.7780   -97.6610   -76.4881   -52.2324   -29.0429   -20.4899 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -844.3736 (63)
Output from w/h
              141.6273   104.8249    81.6962    39.9825    13.6371     0.0000     0.0000    21.7434    43.7257    86.0620   120.1707   140.8297 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =    794.2995 (64)
Heat gains from water heating, kWh/month
               54.0220    47.3481    49.0967    43.1413    41.6458    36.3070    34.0107    38.5064    38.8121    44.7810    48.4456    52.4296 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               49.6942    44.1380    35.8954    27.1751    20.3137    17.1497    18.5309    24.0871    32.3297    41.0499    47.9113    51.0754 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              328.5195   331.9285   323.3379   305.0496   281.9638   260.2665   245.7713   242.3623   250.9529   269.2413   292.3270   314.0243 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562 (71)
Water heating gains (Table 5)
               72.6102    70.4585    65.9902    59.9185    55.9756    50.4264    45.7133    51.7559    53.9058    60.1895    67.2855    70.4699 (72)
Total internal gains
              555.4843   551.1854   529.8840   496.8036   462.9135   432.5030   414.6759   422.8658   441.8488   475.1411   512.1843   540.2300 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data    Specific data       factor                W
                                                          W/m2      or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                                3.6300           11.2829           0.4600           0.0000           0.7700           14.5070 (75)
Southwest                                4.6800           36.7938           0.4600           0.0000           0.7700           60.9915 (79)
Northwest                                2.4700           11.2829           0.4600           0.0000           0.7700            9.8712 (81)
Southwest                                4.5100           36.7938           0.4600           0.0000           0.7700           58.7760 (79)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    144.1457   253.6308   368.5370   492.6864   584.7555   595.0010   567.6210   496.7204   411.1822   286.1153   174.1279   122.4045 (83)
Total gains    699.6300   804.8162   898.4210   989.4900  1047.6691  1027.5040   982.2970   919.5862   853.0310   761.2564   686.3122   662.6344 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                           21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            32.7677    32.8624    32.9558    33.4015    33.4863    33.8865    33.8865    33.9617    33.7312    33.4863    33.3153    33.1384
alpha           3.1845     3.1908     3.1971     3.2268     3.2324     3.2591     3.2591     3.2641     3.2487     3.2324     3.2210     3.2092
util living area
                0.9628     0.9419     0.9040     0.8282     0.7081     0.5511     0.4172     0.4590     0.6665     0.8611     0.9430     0.9680 (86)

MIT            19.3126    19.5632    19.9308    20.3721    20.7114    20.9085    20.9721    20.9617    20.8246    20.3812    19.7737    19.2667 (87)
Th 2           19.8826    19.8854    19.8882    19.9014    19.9038    19.9153    19.9153    19.9175    19.9109    19.9038    19.8988    19.8936 (88)
util rest of house
                0.9556     0.9310     0.8859     0.7960     0.6549     0.4733     0.3211     0.3605     0.5917     0.8275     0.9304     0.9618 (89)
MIT 2          17.6755    18.0350    18.5563    19.1711    19.6099    19.8440    19.9011    19.8963    19.7593    19.2014    18.3510    17.6168 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2505 (91)
MIT            18.0856    18.4178    18.9006    19.4719    19.8859    20.1107    20.1694    20.1632    20.0262    19.4970    18.7074    18.0301 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT   17.9356    18.2678    18.7506    19.3219    19.7359    19.9607    20.0194    20.0132    19.8762    19.3470    18.5574    17.8801 (93)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9383	0.9102	0.8630	0.7764	0.6459	0.4767	0.3306	0.3696	0.5891	0.8069	0.9100	0.9459	(94)
Useful gains	656.4570	732.5763	775.2946	768.1910	676.7294	489.8305	324.7689	339.8459	502.4796	614.2864	624.5758	626.7674	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1365.7515	1335.0716	1220.0337	1024.0622	787.6077	519.2015	331.1788	349.1780	562.0228	857.3032	1128.7218	1354.8857	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	527.7151	404.8769	330.8859	184.2273	82.4935	0.0000	0.0000	0.0000	0.0000	180.8045	362.9851	541.7200	(98)
Space heating												2615.7082	(98)
Space heating per m2											(98) / (4) =	32.5661	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2890.2853	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	527.7151	404.8769	330.8859	184.2273	82.4935	0.0000	0.0000	0.0000	0.0000	180.8045	362.9851	541.7200	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	583.1106	447.3777	365.6197	203.5661	91.1530	0.0000	0.0000	0.0000	0.0000	199.7840	401.0885	598.5857	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8035	89.8229	89.8479	89.9123	90.0318	87.3000	87.3000	87.3000	87.3000	89.4427	89.6824	89.8207	(217)
Fuel for water heating, kWh/month	157.7080	116.7018	90.9273	44.4683	15.1470	0.0000	0.0000	24.9065	50.0868	96.2203	133.9959	156.7899	(219)
Water heating fuel used												886.9516	(219)
Annual totals kWh/year													
Space heating fuel - main system												2890.2853	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2526.0437	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2890.2853	3.4800	100.5819	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9516	3.4800	30.8659	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			86.4155	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.2896	(257)
SAP value	95.9599	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2890.2853	0.2160	624.3016	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9516	0.2160	191.5816	(264)
Space and water heating			815.8832	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			166.5139	(272)
CO2 emissions per m2			2.0700	(273)
EI value			98.2195	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3113	(H8)
Utilisation factor												0.5336	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-860.2505	(H17)
Solar input	-26.4781	-39.7965	-67.0223	-92.6454	-111.5762	-117.4291	-114.6094	-102.3469	-79.8821	-54.3423	-32.1848	-21.9373	(63)
											Solar input (sum of months) = Sum(63)m =	-860.2505	(63)
Output from w/h													
	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
											Total per year (kWh/year) = Sum(64)m =	785.4083	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	12.9236	0.4600	0.0000	0.7700	16.6164	(75)
Southwest	4.6800	40.4699	0.4600	0.0000	0.7700	67.0852	(79)
Northwest	2.4700	12.9236	0.4600	0.0000	0.7700	11.3065	(81)
Southwest	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(79)

Solar gains	159.6564	253.2748	365.1052	505.8802	587.2368	640.3388	603.9261	538.8796	442.5495	305.4854	197.6762	134.2162	(83)
Total gains	715.1408	804.4602	894.9892	1002.6838	1050.1503	1072.8418	1018.6020	961.7454	884.3983	780.6265	709.8605	674.4461	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9546	0.9339	0.8879	0.7906	0.6382	0.4286	0.2886	0.3132	0.5696	0.8190	0.9257	0.9607	(86)
MIT	19.5158	19.7262	20.0987	20.5217	20.8241	20.9667	20.9936	20.9916	20.9108	20.5462	19.9840	19.4769	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9457	0.9213	0.8663	0.7519	0.5746	0.3433	0.1901	0.2106	0.4826	0.7757	0.9091	0.9529	(89)
MIT 2	17.9832	18.2845	18.8073	19.3814	19.7545	19.9056	19.9218	19.9248	19.8601	19.4322	18.6639	17.9340	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3671	18.6457	19.1308	19.6670	20.0224	20.1714	20.1903	20.1921	20.1233	19.7113	18.9946	18.3205	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2171	18.4957	18.9808	19.5170	19.8724	20.0214	20.0403	20.0421	19.9733	19.5613	18.8446	18.1705	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9002	0.8440	0.7356	0.5717	0.3512	0.2009	0.2217	0.4868	0.7588	0.8878	0.9356	(94)
Useful gains	663.0159	724.2006	755.4063	737.6201	600.4001	376.7287	204.6679	213.2596	430.5051	592.3164	630.2240	630.9921	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1282.4423	1254.7454	1126.8087	929.3866	664.1491	385.4059	205.5319	214.4618	457.4691	766.0991	1043.5533	1265.9265	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	460.8533	356.5260	276.3234	138.0719	47.4293	0.0000	0.0000	0.0000	0.0000	129.2943	297.5971	472.3912	(98)
Space heating												2178.4865	(98)
Space heating per m2											(98) / (4) =	27.1226	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2407.1675	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	460.8533	356.5260	276.3234	138.0719	47.4293	0.0000	0.0000	0.0000	0.0000	129.2943	297.5971	472.3912	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	509.2301	393.9514	305.3297	152.5656	52.4080	0.0000	0.0000	0.0000	0.0000	142.8667	328.8366	521.9792	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7351	89.7467	89.7314	89.7525	89.6229	87.3000	87.3000	87.3000	87.3000	89.2126	89.5733	89.7505	(217)
Fuel for water heating, kWh/month	155.6072	117.9843	93.9034	45.2326	19.2765	0.0000	0.0000	19.5389	46.1990	94.1034	130.6515	155.2999	(219)
Water heating fuel used												877.7968	(219)
Annual totals kWh/year													
Space heating fuel - main system												2407.1675	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												1936.8507	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2407.1675	3.9200	94.3610	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.7968	3.9200	34.4096	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-11.8695	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2407.1675	0.2160	519.9482	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7968	0.2160	189.6041	(264)
Space and water heating			709.5523	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			9.8814	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2407.1675	1.2200	2936.7443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7968	1.2200	1070.9121	(264)
Space and water heating			4007.6563	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-131.0522	(272)
Primary energy kWh/m2/year			-1.6316	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.6300	98.8453	0.4600	0.0000	0.9000	148.5466
South West	4.6800	119.9223	0.4600	0.0000	0.9000	232.3519
North West	2.4700	98.8453	0.4600	0.0000	0.9000	101.0772
South West	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						705.8876

	Jun	Jul	Aug	
Solar gains	748	706	630	(P4)
Internal gains	430	412	420	
Total summer gains	1178	1118	1050	(P5)
Summer gain/loss ratio	3.54	3.36	3.16	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.51	22.23	21.93	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-344	**Issued on Date**	19/10/2022
Assessment Reference	Plot 344	**Prop Type Ref**	2-Opp-SEMI
Property	Plot 344, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	16.73	**TER**	18.35
Environmental	87 B	**% DER<TER**	8.80		
CO_2 Emissions (t/year)	1.12	**DFEE**	44.97	**TFEE**	52.14
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.75		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.35 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.73 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.0 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.63 m², No overhang
Windows facing South East: 1.64 m², No overhang
Windows facing South West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.038 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	99.1800	98.8913	98.6084	97.2793	97.0306	95.8730	95.8730	95.6586	96.3189	97.0306	97.5337	98.0596	(39)
Average = Sum(39)m / 12 =												97.2781	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2348	1.2312	1.2277	1.2111	1.2081	1.1936	1.1936	1.1910	1.1992	1.2081	1.2143	1.2209	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.7932	373.6847	360.1366	338.2948	316.1173	294.7548	280.8870	286.8864	298.1161	320.1699	345.5005	364.4981	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	531.4408	643.6288	742.2850	833.2487	890.0885	873.1887	834.9745	780.7066	719.1231	621.9666	532.8080	497.1322	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2134	33.3103	33.4059	33.8623	33.9491	34.3590	34.3590	34.4360	34.1999	33.9491	33.7740	33.5929	
alpha	3.2142	3.2207	3.2271	3.2575	3.2633	3.2906	3.2906	3.2957	3.2800	3.2633	3.2516	3.2395	
util living area													
	0.9823	0.9671	0.9382	0.8769	0.7707	0.6188	0.4773	0.5230	0.7353	0.9094	0.9703	0.9855	(86)
MIT	19.0828	19.3594	19.7580	20.2408	20.6316	20.8748	20.9602	20.9458	20.7682	20.2451	19.5747	19.0364	(87)
Th 2	19.8923	19.8951	19.8979	19.9111	19.9136	19.9251	19.9251	19.9272	19.9206	19.9136	19.9086	19.9033	(88)
util rest of house													
	0.9786	0.9603	0.9253	0.8508	0.7215	0.5385	0.3717	0.4163	0.6638	0.8844	0.9631	0.9825	(89)
MIT 2	17.3513	17.7522	18.3247	19.0087	19.5278	19.8243	19.9040	19.8962	19.7125	19.0319	18.0764	17.2908	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7851	18.1548	18.6837	19.3173	19.8043	20.0874	20.1686	20.1591	19.9769	19.3358	18.4517	17.7281	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6351	18.0048	18.5337	19.1673	19.6543	19.9374	20.0186	20.0091	19.8269	19.1858	18.3017	17.5781	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9674	0.9443	0.9045	0.8292	0.7083	0.5395	0.3813	0.4249	0.6567	0.8629	0.9479	0.9728	(94)
Useful gains	514.1035	607.7513	671.3602	690.9148	630.4143	471.1136	318.4035	331.7523	472.2669	536.7068	505.0715	483.5934	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1322.5715	1295.9522	1186.6235	998.7991	771.8083	511.7155	327.7485	345.2400	551.6113	833.0819	1092.5407	1311.8477	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	601.5002	462.4710	383.3559	221.6767	105.1972	0.0000	0.0000	0.0000	0.0000	220.5031	422.9779	616.2212	(98)
Space heating												3033.9032	(98)
Space heating per m2											(98) / (4) =	37.7727	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3352.3792	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	601.5002	462.4710	383.3559	221.6767	105.1972	0.0000	0.0000	0.0000	0.0000	220.5031	422.9779	616.2212	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	664.6411	511.0177	423.5977	244.9467	116.2400	0.0000	0.0000	0.0000	0.0000	243.6498	467.3789	680.9074	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7878	89.7123	89.5710	89.2715	88.7098	87.3000	87.3000	87.3000	87.3000	89.2392	89.6431	89.8169	(217)
Fuel for water heating, kWh/month													
	185.0056	162.3898	168.8976	149.2556	145.2515	129.0595	121.2740	136.7748	137.7020	154.9705	166.4529	179.6094	(219)
Water heating fuel used												1836.6432	(219)
Annual totals kWh/year													
Space heating fuel - main system												3352.3792	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Total delivered energy for all uses												5617.9584	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3352.3792	0.2160	724.1139	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.6432	0.2160	396.7149	(264)
Space and water heating			1120.8288	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Total CO2, kg/year			1343.4466	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.7300	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.1883	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.1883	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.4600	1.3258	19.1705			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.1800	13.6998			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.4419			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.7401	(36)
Total fabric heat loss (33) + (36) =	55.1820	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.8560	96.5680	96.2858	94.9601	94.7120	93.5573	93.5573	93.3435	94.0021	94.7120	95.2138	95.7384	(39)
Average = Sum(39)m / 12 =												94.9589	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2059	1.2023	1.1988	1.1823	1.1792	1.1648	1.1648	1.1621	1.1703	1.1792	1.1854	1.1920	(40)
HLP (average)												1.1823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.9866	385.6125	371.4435	348.9834	326.1824	304.1988	290.3398	296.9598	308.8170	331.4892	357.4353	376.6963	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southeast	1.6400	36.7938	0.6300	0.7000	0.7700	18.4413	(77)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)

Solar gains	134.2968	232.9148	329.7277	427.0591	495.2373	499.0878	478.0811	426.0809	363.2559	260.3981	161.6138	114.4402	(83)
Total gains	522.2834	618.5273	701.1712	776.0425	821.4197	803.2866	768.4210	723.0407	672.0729	591.8873	519.0491	491.1365	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.5884	57.7601	57.9294	58.7381	58.8920	59.6188	59.6188	59.7554	59.3367	58.8920	58.5816	58.2606	
alpha	4.8392	4.8507	4.8620	4.9159	4.9261	4.9746	4.9746	4.9837	4.9558	4.9261	4.9054	4.8840	
util living area													
	0.9971	0.9931	0.9822	0.9477	0.8589	0.6922	0.5243	0.5751	0.8170	0.9659	0.9938	0.9979	(86)
MIT	19.7306	19.9107	20.1801	20.5193	20.7961	20.9502	20.9898	20.9841	20.8840	20.5193	20.0617	19.7023	(87)
Th 2	19.9153	19.9182	19.9210	19.9342	19.9367	19.9483	19.9483	19.9504	19.9438	19.9367	19.9317	19.9264	(88)
util rest of house													
	0.9962	0.9907	0.9759	0.9286	0.8091	0.5992	0.4049	0.4532	0.7388	0.9496	0.9913	0.9972	(89)
MIT 2	18.2333	18.4975	18.8890	19.3772	19.7399	19.9157	19.9446	19.9441	19.8537	19.3877	18.7283	18.1999	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.6084	18.8515	19.2124	19.6633	20.0045	20.1749	20.2064	20.2046	20.1118	19.6712	19.0623	18.5762	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6084	18.8515	19.2124	19.6633	20.0045	20.1749	20.2064	20.2046	20.1118	19.6712	19.0623	18.5762	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9875	0.9704	0.9227	0.8127	0.6205	0.4350	0.4838	0.7528	0.9443	0.9884	0.9958	(94)
Useful gains	519.3792	610.7812	680.4276	716.0282	667.5863	498.4789	334.2280	349.8334	505.9492	558.8904	513.0098	489.0721	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1385.8505	1347.2665	1224.0226	1022.0843	786.5370	521.5700	337.4055	355.1345	565.1195	859.1486	1138.9767	1376.3564	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	644.6546	494.9181	404.4347	220.3604	88.4993	0.0000	0.0000	0.0000	0.0000	223.3922	450.6962	660.1395	(98)
Space heating												3187.0951	(98)
Space heating per m2											(98) / (4) =	39.6800	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3412.3074	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	644.6546	494.9181	404.4347	220.3604	88.4993	0.0000	0.0000	0.0000	0.0000	223.3922	450.6962	660.1395	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	690.2084	529.8909	433.0136	235.9319	94.7530	0.0000	0.0000	0.0000	0.0000	239.1779	482.5441	706.7875	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7624	87.4921	86.9677	85.7952	83.6442	80.3000	80.3000	80.3000	80.3000	85.7106	87.2246	87.8541	(217)
Fuel for water heating, kWh/month													
	230.6229	203.1560	212.6453	191.1832	189.8590	174.1812	166.8789	186.0308	188.0853	200.6526	210.4750	224.9429	(219)
Water heating fuel used												2378.7131	(219)
Annual totals kWh/year													
Space heating fuel - main system												3412.3074	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Total delivered energy for all uses												6219.9565	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3412.3074	0.2160	737.0584	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2378.7131	0.2160	513.8020	(264)
Space and water heating			1250.8604	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Total CO2, kg/m2/year			1473.4782	(272)
Emissions per m2 for space and water heating			15.5735	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2870	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.5735 * 1.00) + 2.2870 + 0.4846, rounded to 2 d.p.			18.3500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	99.1800	98.8913	98.6084	97.2793	97.0306	95.8730	95.8730	95.6586	96.3189	97.0306	97.5337	98.0596	(39)
Average = Sum(39)m / 12 =												97.2781	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2348	1.2312	1.2277	1.2111	1.2081	1.1936	1.1936	1.1910	1.1992	1.2081	1.2143	1.2209	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.4373	342.1100	330.1841	310.5448	289.7982	270.4479	258.2867	262.0955	272.5440	292.3188	315.0754	332.9178	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	499.0849	612.0541	712.3325	805.4987	863.7694	848.8817	812.3742	755.9157	693.5510	594.1155	502.3829	465.5519	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2134	33.3103	33.4059	33.8623	33.9491	34.3590	34.3590	34.4360	34.1999	33.9491	33.7740	33.5929	
alpha	3.2142	3.2207	3.2271	3.2575	3.2633	3.2906	3.2906	3.2957	3.2800	3.2633	3.2516	3.2395	
util living area													
	0.9851	0.9712	0.9441	0.8855	0.7819	0.6312	0.4885	0.5368	0.7498	0.9185	0.9747	0.9880	(86)
MIT	19.0315	19.3120	19.7176	20.2111	20.6136	20.8671	20.9573	20.9414	20.7533	20.2111	19.5282	18.9855	(87)
Th 2	19.8923	19.8951	19.8979	19.9111	19.9136	19.9251	19.9251	19.9272	19.9206	19.9136	19.9086	19.9033	(88)
util rest of house													
	0.9820	0.9652	0.9322	0.8606	0.7338	0.5507	0.3812	0.4285	0.6794	0.8953	0.9684	0.9854	(89)
MIT 2	18.1068	18.3858	18.7852	19.2682	19.6358	19.8515	19.9096	19.9041	19.7680	19.2807	18.6124	18.0693	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3384	18.6178	19.0188	19.5044	19.8807	20.1059	20.1720	20.1640	20.0148	19.5138	18.8418	18.2988	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3384	18.6178	19.0188	19.5044	19.8807	20.1059	20.1720	20.1640	20.0148	19.5138	18.8418	18.2988	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9562	0.9205	0.8497	0.7321	0.5652	0.4070	0.4537	0.6862	0.8849	0.9603	0.9803	(94)
Useful gains	487.0888	585.2409	655.6944	684.4028	632.3958	479.7995	330.6250	342.9872	475.9392	525.7051	482.4338	456.3762	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1392.3298	1356.5702	1234.4544	1031.5902	793.7818	527.8713	342.4617	360.0561	569.7085	864.9101	1145.2183	1382.5247	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	673.4994	518.3333	430.5975	249.9750	120.0712	0.0000	0.0000	0.0000	0.0000	252.3685	477.2048	689.0545	(98)
Space heating												3411.1041	(98)
Space heating per m2											(98) / (4) =	42.4689	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	901.2062	709.4602	727.0056	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8323	0.8880	0.8652	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	750.0832	629.9902	629.0142	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1084.4287	1039.8629	975.4656	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	240.7288	304.9453	257.7599	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												803.4339	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	60.1822	76.2363	64.4400	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												200.8585	(107)
Space cooling per m2												2.5007	(108)
Energy for space heating												42.4689	(99)
Energy for space cooling												2.5007	(108)
Total												44.9697	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.0	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.4600	1.3258	19.1705			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.1800	13.6998			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.4419			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.7401	(36)
Total fabric heat loss (33) + (36) =	55.1820	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.8560	96.5680	96.2858	94.9601	94.7120	93.5573	93.5573	93.3435	94.0021	94.7120	95.2138	95.7384	(39)
Average = Sum(39)m / 12 =												94.9589	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2059	1.2023	1.1988	1.1823	1.1792	1.1648	1.1648	1.1621	1.1703	1.1792	1.1854	1.1920	(40)
HLP (average)												1.1823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.0413	17.8005	14.4764	10.9595	8.1924	6.9164	7.4734	9.7142	13.0383	16.5552	19.3223	20.5983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.4373	342.1100	330.1841	310.5448	289.7982	270.4479	258.2867	262.0955	272.5440	292.3188	315.0754	332.9178	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southeast	1.6400	36.7938	0.6300	0.7000	0.7700	18.4413	(77)
Southwest	9.1900	36.7938	0.6300	0.7000	0.7700	103.3385	(79)

Solar gains	134.2968	232.9148	329.7277	427.0591	495.2373	499.0878	478.0811	426.0809	363.2559	260.3981	161.6138	114.4402	(83)
Total gains	477.7341	575.0248	659.9117	737.6039	785.0355	769.5357	736.3679	688.1765	635.7999	552.7169	476.6892	447.3579	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.5884	57.7601	57.9294	58.7381	58.8920	59.6188	59.6188	59.7554	59.3367	58.8920	58.5816	58.2606	
alpha	4.8392	4.8507	4.8620	4.9159	4.9261	4.9746	4.9746	4.9837	4.9558	4.9261	4.9054	4.8840	
util living area													
	0.9981	0.9949	0.9860	0.9563	0.8753	0.7143	0.5449	0.6002	0.8403	0.9737	0.9957	0.9986	(86)
MIT	19.6797	19.8619	20.1360	20.4843	20.7747	20.9427	20.9879	20.9809	20.8668	20.4803	20.0139	19.6520	(87)
Th 2	19.9153	19.9182	19.9210	19.9342	19.9367	19.9483	19.9483	19.9504	19.9438	19.9367	19.9317	19.9264	(88)
util rest of house													
	0.9974	0.9932	0.9810	0.9397	0.8286	0.6213	0.4219	0.4749	0.7660	0.9605	0.9939	0.9981	(89)
MIT 2	18.7162	18.8999	19.1736	19.5219	19.7859	19.9223	19.9453	19.9451	19.8712	19.5257	19.0627	18.6974	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.9576	19.1409	19.4147	19.7630	20.0336	20.1779	20.2064	20.2046	20.1206	19.7648	19.3010	18.9366	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9576	19.1409	19.4147	19.7630	20.0336	20.1779	20.2064	20.2046	20.1206	19.7648	19.3010	18.9366	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9915	0.9779	0.9365	0.8335	0.6431	0.4530	0.5066	0.7803	0.9578	0.9925	0.9975	(94)
Useful gains	476.1018	570.1237	645.3286	690.7497	654.3246	494.8769	333.6060	348.6489	496.0974	529.3788	473.1133	446.2379	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1419.6719	1375.2111	1243.4988	1031.5520	789.2947	521.8546	337.4081	355.1306	565.9514	868.0156	1161.7019	1410.8543	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	702.0162	541.0187	445.0386	245.3777	100.4178	0.0000	0.0000	0.0000	0.0000	251.9458	495.7838	717.6746	(98)
Space heating												3499.2732	(98)
Space heating per m2											(98) / (4) =	43.5666	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	879.4390	692.3243	709.4107	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8784	0.9340	0.9137	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	772.5042	646.6565	648.1751	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	991.6866	951.0243	896.2899	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	157.8113	226.4497	184.5974	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												568.8584	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	39.4528	56.6124	46.1494	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												142.2146 (107)
Space cooling per m2												1.7706 (108)
Energy for space heating												43.5666 (99)
Energy for space cooling												1.7706 (108)
Total												45.3372 (109)
Target Fabric Energy Efficiency (TFEE)												52.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	96.7876	96.3189	96.3189	95.6586	95.6586	94.8583	95.0498	94.6725	94.8583	95.2470	95.2470	95.8730	(39)
Average = Sum(39)m / 12 =												95.5457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2050	1.1992	1.1992	1.1910	1.1910	1.1810	1.1834	1.1787	1.1810	1.1858	1.1858	1.1936	(40)
HLP (average)												1.1896	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m
22.7162 19.8677 20.5017 17.8739 17.1504 14.7995 13.7139 15.7369 15.9249 18.5589 20.2585 21.9994 (46)
Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 14.6712 13.2321 14.6052 14.0835 14.5162 14.0056 14.4461 14.4916 14.0481 14.5684 14.1570 14.6569 (61)
Total heat required for water heating calculated for each month
166.1124 145.6836 151.2832 133.2428 128.8524 112.6690 105.8722 119.4044 120.2139 138.2944 149.2136 161.3196 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
166.1124 145.6836 151.2832 133.2428 128.8524 112.6690 105.8722 119.4044 120.2139 138.2944 149.2136 161.3196 (64)
Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month
54.0220 47.3481 49.0967 43.1413 41.6458 36.3070 34.0107 38.5064 38.8121 44.7810 48.4456 52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	12.9236	0.4600	0.0000	0.7700	16.6164	(75)
Southeast	1.6400	40.4699	0.4600	0.0000	0.7700	23.5085	(77)
Southwest	4.6800	40.4699	0.4600	0.0000	0.7700	67.0852	(79)
Southwest	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(79)

Solar gains	171.8584	268.4788	376.6843	505.6005	573.8780	620.1099	587.1104	533.1157	450.7576	320.7885	211.9186	145.0171	(83)
Total gains	727.7519	820.0276	906.8637	1002.6279	1036.9587	1052.7541	1001.9389	956.1798	892.8726	796.2675	724.4973	685.6676	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0343	34.1999	34.1999	34.4360	34.4360	34.7265	34.6566	34.7947	34.7265	34.5848	34.5848	34.3590	
alpha	3.2690	3.2800	3.2800	3.2957	3.2957	3.3151	3.3104	3.3196	3.3151	3.3057	3.3057	3.2906	
util living area													
	0.9525	0.9305	0.8838	0.7887	0.6405	0.4323	0.2905	0.3120	0.5620	0.8106	0.9217	0.9590	(86)
MIT	19.5592	19.7710	20.1325	20.5365	20.8272	20.9672	20.9938	20.9921	20.9170	20.5721	20.0232	19.5188	(87)
Th 2	19.9160	19.9206	19.9206	19.9272	19.9272	19.9352	19.9333	19.9371	19.9352	19.9313	19.9313	19.9251	(88)
util rest of house													
	0.9432	0.9174	0.8618	0.7499	0.5773	0.3471	0.1922	0.2106	0.4760	0.7664	0.9044	0.9508	(89)
MIT 2	18.0507	18.3537	18.8600	19.4081	19.7669	19.9155	19.9316	19.9348	19.8746	19.4717	18.7245	17.9996	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4285	18.7087	19.1788	19.6908	20.0325	20.1790	20.1977	20.1996	20.1357	19.7474	19.0498	18.3801	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2785	18.5587	19.0288	19.5408	19.8825	20.0290	20.0477	20.0496	19.9857	19.5974	18.8998	18.2301	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9245	0.8964	0.8399	0.7342	0.5744	0.3549	0.2029	0.2216	0.4804	0.7504	0.8832	0.9334	(94)
Useful gains	672.8318	735.0383	761.7092	736.1129	595.6780	373.6100	203.2977	211.8450	428.9149	597.5536	639.8662	640.0138	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1275.5206	1248.1693	1120.0720	922.2235	658.3679	382.1818	204.1375	212.9787	453.9676	761.7275	1038.1770	1258.8242	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	448.4005	344.8240	266.6219	133.9996	46.6413	0.0000	0.0000	0.0000	0.0000	122.1454	286.7838	460.3949	(98)
Space heating												2109.8114	(98)
RHI space heating demand												2110	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	99.1800	98.8913	98.6084	97.2793	97.0306	95.8730	95.8730	95.6586	96.3189	97.0306	97.5337	98.0596	(39)
Average = Sum(39)m / 12 =												97.2781	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2348	1.2312	1.2277	1.2111	1.2081	1.1936	1.1936	1.1910	1.1992	1.2081	1.2143	1.2209	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	711.5411	821.4929	912.3279	991.9812	1037.0520	1011.0780	968.9160	916.8843	863.1220	777.2758	699.8862	673.2846	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2134	33.3103	33.4059	33.8623	33.9491	34.3590	34.3590	34.4360	34.1999	33.9491	33.7740	33.5929	
alpha	3.2142	3.2207	3.2271	3.2575	3.2633	3.2906	3.2906	3.2957	3.2800	3.2633	3.2516	3.2395	
util living area													
	0.9612	0.9388	0.9002	0.8259	0.7097	0.5546	0.4190	0.4567	0.6584	0.8540	0.9400	0.9667	(86)
MIT	19.3564	19.6111	19.9694	20.3914	20.7168	20.9097	20.9729	20.9636	20.8356	20.4122	19.8142	19.3094	(87)
Th 2	19.8923	19.8951	19.8979	19.9111	19.9136	19.9251	19.9251	19.9272	19.9206	19.9136	19.9086	19.9033	(88)
util rest of house													
	0.9537	0.9274	0.8816	0.7936	0.6568	0.4771	0.3233	0.3593	0.5839	0.8195	0.9269	0.9602	(89)
MIT 2	17.7438	18.1085	18.6159	19.2038	19.6248	19.8546	19.9112	19.9072	19.7791	19.2486	18.4139	17.6836	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.1478	18.4849	18.9550	19.5013	19.8983	20.1189	20.1771	20.1718	20.0437	19.5401	18.7646	18.0909	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9978	18.3349	18.8050	19.3513	19.7483	19.9689	20.0271	20.0218	19.8937	19.3901	18.6146	17.9409	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9066	0.8589	0.7744	0.6480	0.4804	0.3327	0.3682	0.5819	0.7997	0.9065	0.9442	(94)
Useful gains	666.1817	744.7446	783.5690	768.2358	671.9957	485.7291	322.3238	337.6006	502.2334	621.5512	634.4559	635.7081	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1358.5469	1328.5959	1213.3724	1016.6973	780.9358	514.7309	328.5685	346.4565	558.0460	852.9076	1123.0650	1347.4220	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	515.1197	392.3481	319.7738	178.8922	81.0514	0.0000	0.0000	0.0000	0.0000	172.1291	351.7985	529.5152	(98)
Space heating												2540.6280	(98)
Space heating per m2											(98) / (4) =	31.6313	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2807.3238	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	515.1197	392.3481	319.7738	178.8922	81.0514	0.0000	0.0000	0.0000	0.0000	172.1291	351.7985	529.5152	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	569.1930	433.5338	353.3412	197.6710	89.5596	0.0000	0.0000	0.0000	0.0000	190.1979	388.7276	585.0996	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6983	89.6106	89.4470	89.1057	88.5084	87.3000	87.3000	87.3000	87.3000	89.0459	89.5227	89.7319	(217)
Fuel for water heating, kWh/month													
	185.1902	162.5740	169.1316	149.5333	145.5820	129.0595	121.2740	136.7748	137.7020	155.3069	166.6769	179.7795	(219)
Water heating fuel used												1838.5847	(219)
Annual totals kWh/year													
Space heating fuel - main system												2807.3238	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Total delivered energy for all uses												5074.8446	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2807.3238	3.4800	97.6949	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.5847	3.4800	63.9827	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	353.9360	13.1900	46.6842	(250)
Additional standing charges			120.0000	(251)
Total energy cost			338.2543	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1336	(257)
SAP value		84.1858	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2807.3238	0.2160	606.3819	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.5847	0.2160	397.1343	(264)
Space and water heating			1003.5162	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Total kg/year			1226.1340	(272)
CO2 emissions per m2			15.2700	(273)
EI value			86.8894	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8866 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8866 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445 (8)
Pressure test				Yes
Measured/design AP50				5.0100
Infiltration rate				0.3950 (18)
Number of sides sheltered				1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	96.7876	96.3189	96.3189	95.6586	95.6586	94.8583	95.0498	94.6725	94.8583	95.2470	95.2470	95.8730	(39)
Average = Sum(39)m / 12 =												95.5457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2050	1.1992	1.1992	1.1910	1.1910	1.1810	1.1834	1.1787	1.1810	1.1858	1.1858	1.1936	(40)
HLP (average)												1.1896	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)
Total internal gains												
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	12.9236	0.4600	0.0000	0.7700	16.6164	(75)
Southeast	1.6400	40.4699	0.4600	0.0000	0.7700	23.5085	(77)
Southwest	4.6800	40.4699	0.4600	0.0000	0.7700	67.0852	(79)
Southwest	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(79)

Solar gains	171.8584	268.4788	376.6843	505.6005	573.8780	620.1099	587.1104	533.1157	450.7576	320.7885	211.9186	145.0171 (83)
Total gains	727.7519	820.0276	906.8637	1002.6279	1036.9587	1052.7541	1001.9389	956.1798	892.8726	796.2675	724.4973	685.6676 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0343	34.1999	34.1999	34.4360	34.4360	34.7265	34.6566	34.7947	34.7265	34.5848	34.5848	34.3590	
alpha	3.2690	3.2800	3.2800	3.2957	3.2957	3.3151	3.3104	3.3196	3.3151	3.3057	3.3057	3.2906	
util living area													
	0.9525	0.9305	0.8838	0.7887	0.6405	0.4323	0.2905	0.3120	0.5620	0.8106	0.9217	0.9590	(86)
MIT	19.5592	19.7710	20.1325	20.5365	20.8272	20.9672	20.9938	20.9921	20.9170	20.5721	20.0232	19.5188	(87)
Th 2	19.9160	19.9206	19.9206	19.9272	19.9272	19.9352	19.9333	19.9371	19.9352	19.9313	19.9313	19.9251	(88)
util rest of house													
	0.9432	0.9174	0.8618	0.7499	0.5773	0.3471	0.1922	0.2106	0.4760	0.7664	0.9044	0.9508	(89)
MIT 2	18.0507	18.3537	18.8600	19.4081	19.7669	19.9155	19.9316	19.9348	19.8746	19.4717	18.7245	17.9996	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4285	18.7087	19.1788	19.6908	20.0325	20.1790	20.1977	20.1996	20.1357	19.7474	19.0498	18.3801	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2785	18.5587	19.0288	19.5408	19.8825	20.0290	20.0477	20.0496	19.9857	19.5974	18.8998	18.2301	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9245	0.8964	0.8399	0.7342	0.5744	0.3549	0.2029	0.2216	0.4804	0.7504	0.8832	0.9334	(94)
Useful gains	672.8318	735.0383	761.7092	736.1129	595.6780	373.6100	203.2977	211.8450	428.9149	597.5536	639.8662	640.0138	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1275.5206	1248.1693	1120.0720	922.2235	658.3679	382.1818	204.1375	212.9787	453.9676	761.7275	1038.1770	1258.8242	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	448.4005	344.8240	266.6219	133.9996	46.6413	0.0000	0.0000	0.0000	0.0000	122.1454	286.7838	460.3949	(98)
Space heating												2109.8114	(98)
Space heating per m2											(98) / (4) =	26.2676	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2331.2833	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	448.4005	344.8240	266.6219	133.9996	46.6413	0.0000	0.0000	0.0000	0.0000	122.1454	286.7838	460.3949	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	495.4701	381.0210	294.6098	148.0659	51.5373	0.0000	0.0000	0.0000	0.0000	134.9673	316.8882	508.7237	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6121	89.5254	89.3149	88.8757	88.1282	87.3000	87.3000	87.3000	87.3000	88.7721	89.3788	89.6474	(217)
Fuel for water heating, kWh/month	185.3684	162.7288	169.3819	149.9203	146.2102	129.0595	121.2740	136.7748	137.7020	155.7858	166.9453	179.9491	(219)
Water heating fuel used												1841.1001	(219)
Annual totals kWh/year													
Space heating fuel - main system												2331.2833	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Total delivered energy for all uses												4601.3194	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2331.2833	3.9200	91.3863	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1841.1001	3.9200	72.1711	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	353.9360	16.9600	60.0276	(250)
Additional standing charges			88.0000	(251)
Total energy cost			324.3050	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2331.2833	0.2160	503.5572	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1841.1001	0.2160	397.6776	(264)
Space and water heating			901.2348	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Total kg/year			1123.8526	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2331.2833	1.2200	2844.1656	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1841.1001	1.2200	2246.1421	(264)
Space and water heating			5090.3077	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	353.9360	3.0700	1086.5837	(268)
Primary energy kWh/year			6407.1413	(272)
Primary energy kWh/m2/year			79.7702	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (16.2%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (100.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 89
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£81	-£8
Mains gas	£252	£214	£38
Space heating	£192	£192	£0
Water heating	£72	£43	£29
Lighting	£60	£60	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£325	-£14	£339
Total cost of uses	£324	-£14	£338
Delivered energy	57 kWh/m²	23 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	80 kWh/m²	-3 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	99.1800	98.8913	98.6084	97.2793	97.0306	95.8730	95.8730	95.6586	96.3189	97.0306	97.5337	98.0596	(39)
Average = Sum(39)m / 12 =												97.2781	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2348	1.2312	1.2277	1.2111	1.2081	1.1936	1.1936	1.1910	1.1992	1.2081	1.2143	1.2209	(40)
HLP (average)												1.2111	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2416	(H8)
Utilisation factor												0.5531	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-844.3736	(H17)
Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899	(63)
											Solar input (sum of months) = Sum(63)m =	-844.3736	(63)
Output from w/h													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
											Total per year (kWh/year) = Sum(64)m =	794.2995	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	1.6400	36.7938	0.4600	0.0000	0.7700	21.3731	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	155.6476	269.9441	382.1485	494.9539	573.9712	578.4338	554.0875	493.8202	421.0070	301.7967	187.3075	132.6341	(83)
Total gains	711.5411	821.4929	912.3279	991.9812	1037.0520	1011.0780	968.9160	916.8843	863.1220	777.2758	699.8862	673.2846	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.2134	33.3103	33.4059	33.8623	33.9491	34.3590	34.3590	34.4360	34.1999	33.9491	33.7740	33.5929	
alpha	3.2142	3.2207	3.2271	3.2575	3.2633	3.2906	3.2906	3.2957	3.2800	3.2633	3.2516	3.2395	
util living area													
	0.9612	0.9388	0.9002	0.8259	0.7097	0.5546	0.4190	0.4567	0.6584	0.8540	0.9400	0.9667	(86)
MIT	19.3564	19.6111	19.9694	20.3914	20.7168	20.9097	20.9729	20.9636	20.8356	20.4122	19.8142	19.3094	(87)
Th 2	19.8923	19.8951	19.8979	19.9111	19.9136	19.9251	19.9251	19.9272	19.9206	19.9136	19.9086	19.9033	(88)
util rest of house													
	0.9537	0.9274	0.8816	0.7936	0.6568	0.4771	0.3233	0.3593	0.5839	0.8195	0.9269	0.9602	(89)
MIT 2	17.7438	18.1085	18.6159	19.2038	19.6248	19.8546	19.9112	19.9072	19.7791	19.2486	18.4139	17.6836	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.1478	18.4849	18.9550	19.5013	19.8983	20.1189	20.1771	20.1718	20.0437	19.5401	18.7646	18.0909	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9978	18.3349	18.8050	19.3513	19.7483	19.9689	20.0271	20.0218	19.8937	19.3901	18.6146	17.9409	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9066	0.8589	0.7744	0.6480	0.4804	0.3327	0.3682	0.5819	0.7997	0.9065	0.9442	(94)
Useful gains	666.1817	744.7446	783.5690	768.2358	671.9957	485.7291	322.3238	337.6006	502.2334	621.5512	634.4559	635.7081	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1358.5469	1328.5959	1213.3724	1016.6973	780.9358	514.7309	328.5685	346.4565	558.0460	852.9076	1123.0650	1347.4220	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	515.1197	392.3481	319.7738	178.8922	81.0514	0.0000	0.0000	0.0000	0.0000	172.1291	351.7985	529.5152	(98)
Space heating												2540.6280	(98)
Space heating per m2											(98) / (4) =	31.6313	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2807.3238	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	515.1197	392.3481	319.7738	178.8922	81.0514	0.0000	0.0000	0.0000	0.0000	172.1291	351.7985	529.5152	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	569.1930	433.5338	353.3412	197.6710	89.5596	0.0000	0.0000	0.0000	0.0000	190.1979	388.7276	585.0996	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7902	89.8059	89.8300	89.8981	90.0247	87.3000	87.3000	87.3000	87.3000	89.4076	89.6632	89.8084	(217)
Fuel for water heating, kWh/month	157.7313	116.7238	90.9454	44.4753	15.1482	0.0000	0.0000	24.9065	50.0868	96.2580	134.0246	156.8113	(219)
Water heating fuel used												887.1112	(219)
Annual totals kWh/year													
Space heating fuel - main system												2807.3238	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2446.1316	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2807.3238	3.4800	97.6949	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	887.1112	3.4800	30.8715	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	353.9360	13.1900	46.6842	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			83.9151	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.2812	(257)
SAP value	96.0768	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2807.3238	0.2160	606.3819	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	887.1112	0.2160	191.6160	(264)
Space and water heating			797.9980	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			150.1285	(272)
CO2 emissions per m2			1.8700	(273)
EI value			98.3947	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.9500	1.2357	12.2956			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.5900	76.1100	0.2500	19.0275	52.3000	3980.5530	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.9101			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11858.7630 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.6440 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5771 (36)
Total fabric heat loss	(33) + (36) =	57.4872 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	96.7876	96.3189	96.3189	95.6586	95.6586	94.8583	95.0498	94.6725	94.8583	95.2470	95.2470	95.8730	(39)
Average = Sum(39)m / 12 =												95.5457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2050	1.1992	1.1992	1.1910	1.1910	1.1810	1.1834	1.1787	1.1810	1.1858	1.1858	1.1936	(40)
HLP (average)												1.1896	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3113	(H8)
Utilisation factor												0.5336	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-860.2505	(H17)
Solar input	-26.4781	-39.7965	-67.0223	-92.6454	-111.5762	-117.4291	-114.6094	-102.3469	-79.8821	-54.3423	-32.1848	-21.9373	(63)
											Solar input (sum of months) = Sum(63)m =	-860.2505	(63)
Output from w/h													
	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
											Total per year (kWh/year) = Sum(64)m =	785.4083	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.1033	44.5013	36.1909	27.3988	20.4810	17.2909	18.6834	24.2854	32.5958	41.3879	48.3058	51.4958	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.8934	551.5487	530.1795	497.0273	463.0808	432.6442	414.8285	423.0641	442.1149	475.4791	512.5787	540.6504	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.6300	12.9236	0.4600	0.0000	0.7700	16.6164	(75)
Southeast	1.6400	40.4699	0.4600	0.0000	0.7700	23.5085	(77)
Southwest	4.6800	40.4699	0.4600	0.0000	0.7700	67.0852	(79)
Southwest	4.5100	40.4699	0.4600	0.0000	0.7700	64.6483	(79)

Solar gains	171.8584	268.4788	376.6843	505.6005	573.8780	620.1099	587.1104	533.1157	450.7576	320.7885	211.9186	145.0171	(83)
Total gains	727.7519	820.0276	906.8637	1002.6279	1036.9587	1052.7541	1001.9389	956.1798	892.8726	796.2675	724.4973	685.6676	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0343	34.1999	34.1999	34.4360	34.4360	34.7265	34.6566	34.7947	34.7265	34.5848	34.5848	34.3590	
alpha	3.2690	3.2800	3.2800	3.2957	3.2957	3.3151	3.3104	3.3196	3.3151	3.3057	3.3057	3.2906	
util living area													
	0.9525	0.9305	0.8838	0.7887	0.6405	0.4323	0.2905	0.3120	0.5620	0.8106	0.9217	0.9590	(86)
MIT	19.5592	19.7710	20.1325	20.5365	20.8272	20.9672	20.9938	20.9921	20.9170	20.5721	20.0232	19.5188	(87)
Th 2	19.9160	19.9206	19.9206	19.9272	19.9272	19.9352	19.9333	19.9371	19.9352	19.9313	19.9313	19.9251	(88)
util rest of house													
	0.9432	0.9174	0.8618	0.7499	0.5773	0.3471	0.1922	0.2106	0.4760	0.7664	0.9044	0.9508	(89)
MIT 2	18.0507	18.3537	18.8600	19.4081	19.7669	19.9155	19.9316	19.9348	19.8746	19.4717	18.7245	17.9996	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.4285	18.7087	19.1788	19.6908	20.0325	20.1790	20.1977	20.1996	20.1357	19.7474	19.0498	18.3801	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2785	18.5587	19.0288	19.5408	19.8825	20.0290	20.0477	20.0496	19.9857	19.5974	18.8998	18.2301	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9245	0.8964	0.8399	0.7342	0.5744	0.3549	0.2029	0.2216	0.4804	0.7504	0.8832	0.9334	(94)
Useful gains	672.8318	735.0383	761.7092	736.1129	595.6780	373.6100	203.2977	211.8450	428.9149	597.5536	639.8662	640.0138	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1275.5206	1248.1693	1120.0720	922.2235	658.3679	382.1818	204.1375	212.9787	453.9676	761.7275	1038.1770	1258.8242	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	448.4005	344.8240	266.6219	133.9996	46.6413	0.0000	0.0000	0.0000	0.0000	122.1454	286.7838	460.3949	(98)
Space heating												2109.8114	(98)
Space heating per m2											(98) / (4) =	26.2676	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2331.2833	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	448.4005	344.8240	266.6219	133.9996	46.6413	0.0000	0.0000	0.0000	0.0000	122.1454	286.7838	460.3949	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	495.4701	381.0210	294.6098	148.0659	51.5373	0.0000	0.0000	0.0000	0.0000	134.9673	316.8882	508.7237	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7191	89.7273	89.7103	89.7352	89.6122	87.3000	87.3000	87.3000	87.3000	89.1686	89.5487	89.7356	(217)
Fuel for water heating, kWh/month	155.6351	118.0098	93.9255	45.2413	19.2788	0.0000	0.0000	19.5389	46.1990	94.1498	130.6873	155.3256	(219)
Water heating fuel used												877.9912	(219)

Annual totals kWh/year		
Space heating fuel - main system	2331.2833	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	353.9360	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	1864.0508	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2331.2833	3.9200	91.3863	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9912	3.9200	34.4173	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	353.9360	16.9600	60.0276	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-14.3464	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2331.2833	0.2160	503.5572	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9912	0.2160	189.6461	(264)
Space and water heating			693.2033	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	353.9360	0.5190	183.6928	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			-4.9678	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2331.2833	1.2200	2844.1656	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9912	1.2200	1071.1492	(264)
Space and water heating			3915.3148	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	353.9360	3.0700	1086.5837	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-214.5216	(272)
Primary energy kWh/m2/year			-2.6708	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	57.49	(37)
Summer heat loss coefficient	331.56	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.6300	98.8453	0.4600	0.0000	0.9000	148.5466
South East	1.6400	119.9223	0.4600	0.0000	0.9000	81.4225
South West	4.6800	119.9223	0.4600	0.0000	0.9000	232.3519
South West	4.5100	119.9223	0.4600	0.0000	0.9000	223.9118
total:						686.2329

	Jun	Jul	Aug	
Solar gains	725	686	623	(P4)
Internal gains	430	412	420	
Total summer gains	1154	1098	1043	(P5)
Summer gain/loss ratio	3.48	3.31	3.15	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.6)	0.97	0.97	0.97	
Threshold temperature	20.45	22.18	21.91	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-345	**Issued on Date**	19/10/2022
Assessment Reference	Plot 345	**Prop Type Ref**	2-As-SEMI
Property	Plot 345, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	17.38	**TER**	19.07
Environmental	86 B	**% DER<TER**	8.85		
CO_2 Emissions (t/year)	1.17	**DFEE**	48.17	**TFEE**	56.13
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.20		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.07 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.38 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.2 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 2.47 m², No overhang
Windows facing East: 3.63 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	474.1158	565.7792	677.5414	805.7592	894.9536	890.3713	846.6425	768.5484	668.4888	548.2108	468.0202	445.4253	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9870	0.9766	0.9507	0.8862	0.7707	0.6135	0.4751	0.5332	0.7663	0.9329	0.9790	0.9893	(86)
MIT	18.9652	19.2157	19.6465	20.1929	20.6228	20.8743	20.9592	20.9406	20.7287	20.1361	19.4528	18.9264	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9842	0.9716	0.9400	0.8613	0.7213	0.5329	0.3691	0.4245	0.6971	0.9129	0.9738	0.9870	(89)
MIT 2	17.1760	17.5408	18.1622	18.9380	19.5089	19.8145	19.8938	19.8833	19.6627	18.8789	17.8963	17.1261	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6242	17.9603	18.5340	19.2524	19.7880	20.0800	20.1607	20.1482	19.9297	19.1938	18.2862	17.5770	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4742	17.8103	18.3840	19.1024	19.6380	19.9300	20.0107	19.9982	19.7797	19.0438	18.1362	17.4270	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9751	0.9582	0.9205	0.8391	0.7078	0.5341	0.3789	0.4332	0.6875	0.8919	0.9612	0.9791	(94)
Useful gains	462.2871	542.1051	623.6672	676.1388	633.4256	475.5242	320.7903	332.9201	459.5685	488.9618	449.8540	436.1048	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1319.5382	1289.3861	1183.5203	1002.4860	778.0112	516.2276	330.3404	347.7250	552.6378	827.5892	1087.2296	1310.0133	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	637.7948	502.1728	416.5307	234.9700	107.5717	0.0000	0.0000	0.0000	0.0000	251.9388	458.9104	650.1880	(98)
Space heating												3260.0772	(98)
Space heating per m2											(98) / (4) =	40.5886	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3602.2953	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	637.7948	502.1728	416.5307	234.9700	107.5717	0.0000	0.0000	0.0000	0.0000	251.9388	458.9104	650.1880	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	704.7457	554.8871	460.2549	259.6353	118.8638	0.0000	0.0000	0.0000	0.0000	278.3854	507.0833	718.4397	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8197	89.7601	89.6247	89.3153	88.7275	87.3000	87.3000	87.3000	87.3000	89.3395	89.6933	89.8453	(217)
Fuel for water heating, kWh/month													
	184.9399	162.3032	168.7963	149.1824	145.2226	129.0595	121.2740	136.7748	137.7020	154.7965	166.3598	179.5526	(219)
Water heating fuel used												1835.9637	(219)
Annual totals kWh/year													
Space heating fuel - main system												3602.2953	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Total delivered energy for all uses	5864.3051	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3602.2953	0.2160	778.0958	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1835.9637	0.2160	396.5682	(264)
Space and water heating			1174.6639	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/year			1395.7819	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.3800	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.8383	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.8383	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	84.9765	165.8696	273.9672	403.4177	499.4928	513.9622	488.2012	415.6590	319.6591	196.8763	105.8493	69.9712	(83)
Total gains	472.7995	551.3367	645.2925	752.3116	825.6082	818.1045	778.4800	712.5395	628.3697	528.2303	463.1269	446.4994	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9982	0.9958	0.9874	0.9541	0.8601	0.6881	0.5235	0.5881	0.8484	0.9783	0.9962	0.9986	(86)
MIT	19.6554	19.8169	20.1035	20.4840	20.7897	20.9499	20.9894	20.9818	20.8566	20.4430	19.9827	19.6323	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9975	0.9943	0.9828	0.9368	0.8102	0.5944	0.4031	0.4633	0.7753	0.9671	0.9947	0.9981	(89)
MIT 2	18.1158	18.3534	18.7714	19.3207	19.7223	19.9043	19.9331	19.9317	19.8171	19.2746	18.6056	18.0897	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.5015	18.7200	19.1051	19.6121	19.9897	20.1662	20.1977	20.1947	20.0775	19.5673	18.9506	18.4761	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5015	18.7200	19.1051	19.6121	19.9897	20.1662	20.1977	20.1947	20.0775	19.5673	18.9506	18.4761	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9920	0.9781	0.9305	0.8136	0.6159	0.4334	0.4946	0.7868	0.9620	0.9926	0.9971	(94)
Useful gains	471.0325	546.9069	631.1562	700.0352	671.7431	503.8879	337.3942	352.4276	494.4068	508.1559	459.6785	445.2247	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1391.6717	1350.3103	1228.0500	1029.4260	794.5740	527.0999	340.6861	358.5366	568.7087	859.5202	1141.8340	1383.0331	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	684.9556	539.8871	444.0890	237.1613	91.3862	0.0000	0.0000	0.0000	0.0000	261.4151	491.1520	697.7295	(98)
Space heating												3447.7757	(98)
Space heating per m2											(98) / (4) =	42.9255	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3691.4087	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	684.9556	539.8871	444.0890	237.1613	91.3862	0.0000	0.0000	0.0000	0.0000	261.4151	491.1520	697.7295	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	733.3571	578.0375	475.4700	253.9201	97.8439	0.0000	0.0000	0.0000	0.0000	279.8877	525.8587	747.0337	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8788	87.6688	87.1763	85.9786	83.7164	80.3000	80.3000	80.3000	80.3000	86.1025	87.4087	87.9581	(217)
Fuel for water heating, kWh/month													
	230.3173	202.7465	212.1364	190.7754	189.6952	174.1812	166.8789	186.0308	188.0853	199.7394	210.0317	224.6769	(219)
Water heating fuel used												2375.2950	(219)
Annual totals kWh/year													
Space heating fuel - main system												3691.4087	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6492.7499	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3691.4087	0.2160	797.3443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2375.2950	0.2160	513.0637	(264)
Space and water heating			1310.4080	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1531.5259	(272)
Emissions per m2 for space and water heating			16.3148	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3148 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			19.0700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	441.7599	534.2045	647.5889	778.0092	868.6345	866.0644	824.0422	743.7575	642.9167	520.3597	437.5951	413.8450	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9894	0.9800	0.9560	0.8945	0.7818	0.6256	0.4862	0.5473	0.7809	0.9409	0.9826	0.9913	(86)
MIT	18.9131	19.1667	19.6041	20.1620	20.6047	20.8668	20.9564	20.9359	20.7113	20.0990	19.4048	18.8749	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9871	0.9757	0.9463	0.8709	0.7334	0.5448	0.3784	0.4371	0.7134	0.9228	0.9781	0.9895	(89)
MIT 2	17.9829	18.2364	18.6690	19.2157	19.6198	19.8419	19.8995	19.8921	19.7289	19.1695	18.4846	17.9529	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2159	18.4694	18.9032	19.4527	19.8665	20.0986	20.1643	20.1535	19.9750	19.4023	18.7151	18.1839	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2159	18.4694	18.9032	19.4527	19.8665	20.0986	20.1643	20.1535	19.9750	19.4023	18.7151	18.1839	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9823	0.9683	0.9353	0.8594	0.7316	0.5594	0.4043	0.4626	0.7179	0.9123	0.9716	0.9854	(94)
Useful gains	433.9246	517.2663	605.7143	668.6567	635.4947	484.4584	333.1459	344.0318	461.5561	474.6983	425.1580	407.7943	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1393.8329	1355.2083	1235.2297	1036.9126	800.4118	532.5622	345.2141	362.7415	571.6354	862.7309	1144.2559	1384.9704	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	714.1718	563.0971	468.3595	265.1443	122.6983	0.0000	0.0000	0.0000	0.0000	288.6963	517.7505	727.0190	(98)
Space heating												3666.9367	(98)
Space heating per m2											(98) / (4) =	45.6541	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	910.4273	716.7194	734.4609	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8331	0.8870	0.8564	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	758.4744	635.7111	628.9647	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1104.4372	1053.4195	961.1492	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	249.0932	310.7750	247.1452	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												807.0134	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	62.2733	77.6938	61.7863	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												201.7534	(107)
Space cooling per m2												2.5119	(108)
Energy for space heating												45.6541	(99)
Energy for space cooling												2.5119	(108)
Total												48.1660	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.6300	0.7000	0.7700	8.0268	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	84.9765	165.8696	273.9672	403.4177	499.4928	513.9622	488.2012	415.6590	319.6591	196.8763	105.8493	69.9712	(83)
Total gains	428.2502	507.8342	604.0330	713.8730	789.2241	784.3536	746.4269	677.6752	592.0966	489.0599	420.7670	402.7208	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9988	0.9970	0.9904	0.9619	0.8762	0.7097	0.5438	0.6137	0.8706	0.9840	0.9975	0.9991	(86)
MIT	19.6044	19.7676	20.0585	20.4480	20.7681	20.9426	20.9875	20.9782	20.8362	20.4018	19.9344	19.5819	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9984	0.9960	0.9868	0.9471	0.8295	0.6159	0.4198	0.4856	0.8027	0.9754	0.9965	0.9988	(89)
MIT 2	18.6322	18.7972	19.0884	19.4785	19.7701	19.9110	19.9338	19.9329	19.8399	19.4418	18.9747	18.6185	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.8757	19.0403	19.3314	19.7214	20.0201	20.1694	20.1977	20.1947	20.0894	19.6823	19.2151	18.8599	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8757	19.0403	19.3314	19.7214	20.0201	20.1694	20.1977	20.1947	20.0894	19.6823	19.2151	18.8599	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9842	0.9436	0.8342	0.6380	0.4512	0.5181	0.8145	0.9728	0.9955	0.9984	(94)
Useful gains	427.3189	505.2091	594.5006	673.6110	658.3806	500.3805	336.7678	351.0718	482.2333	475.7561	418.8719	402.0719	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1428.3491	1381.6063	1250.0984	1039.9234	797.4928	527.3991	340.6906	358.5339	569.8427	870.5437	1167.3266	1420.2094	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	744.7665	588.9389	487.7647	263.7450	103.4995	0.0000	0.0000	0.0000	0.0000	293.7220	538.8874	757.4943	(98)
Space heating												3778.8183	(98)
Space heating per m2											(98) / (4) =	47.0470	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8788	0.9329	0.9051	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	782.2537	653.7109	649.8984	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1008.9310	962.7004	883.9101	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	163.2077	229.8882	174.1047	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												567.2005	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   40.8019   57.4720   43.5262    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        141.8001 (107)
Space cooling per m2                                                                                                   1.7654 (108)
Energy for space heating                                                                                              47.0470 (99)
Energy for space cooling                                                                                               1.7654 (108)
Total                                                                                                                 48.8125 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   56.1 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
RHI water heating demand												1632	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	111.8853	196.6193	320.5842	485.5148	584.6116	643.2522	604.6081	527.1755	405.1662	249.1579	142.8116	91.2125	(83)
Total gains	667.3696	747.8047	850.4681	982.3184	1047.5251	1075.7551	1019.2840	950.0413	847.0150	724.2990	654.9959	631.4425	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9620	0.9447	0.8997	0.7980	0.6393	0.4275	0.2884	0.3169	0.5885	0.8430	0.9389	0.9670	(86)
MIT	19.4466	19.6498	20.0484	20.5065	20.8232	20.9670	20.9936	20.9913	20.9017	20.4970	19.9118	19.4131	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9544	0.9339	0.8798	0.7599	0.5757	0.3424	0.1900	0.2131	0.5005	0.8029	0.9246	0.9602	(89)
MIT 2	17.8850	18.1776	18.7396	19.3627	19.7536	19.9057	19.9218	19.9247	19.8528	19.3722	18.5644	17.8431	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2762	18.5464	19.0675	19.6493	20.0215	20.1715	20.1903	20.1919	20.1155	19.6539	18.9019	18.2364	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1262	18.3964	18.9175	19.4993	19.8715	20.0215	20.0403	20.0419	19.9655	19.5039	18.7519	18.0864	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9139	0.8575	0.7431	0.5728	0.3503	0.2008	0.2244	0.5040	0.7844	0.9043	0.9443	(94)
Useful gains	625.4665	683.4240	729.2482	729.9831	599.9801	376.8089	204.6702	213.2011	426.9037	568.1240	592.3074	596.2952	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1273.5514	1245.0852	1120.6463	927.6679	664.0608	385.4223	205.5325	214.4481	456.7228	760.5799	1034.6349	1257.7845	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	482.1752	377.4363	291.2002	142.3330	47.6761	0.0000	0.0000	0.0000	0.0000	143.1872	318.4758	492.1480	(98)
Space heating												2294.6319	(98)
RHI space heating demand												2295	(98)

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	98.4863	192.2399	317.5230	467.5539	578.9032	595.6730	565.8165	481.7413	370.4791	228.1761	122.6775	81.0954	(83)
Total gains	653.9706	743.4253	847.4070	964.3575	1041.8167	1028.1759	980.4924	904.6071	812.3279	703.3172	634.8618	621.3254	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9688	0.9523	0.9158	0.8363	0.7104	0.5508	0.4179	0.4656	0.6874	0.8821	0.9531	0.9730	(86)
MIT	19.2449	19.4785	19.8697	20.3500	20.7085	20.9086	20.9720	20.9601	20.8073	20.3214	19.7021	19.2042	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9626	0.9430	0.8994	0.8050	0.6573	0.4730	0.3216	0.3660	0.6130	0.8519	0.9424	0.9677	(89)
MIT 2	17.5789	17.9155	18.4727	19.1429	19.6067	19.8441	19.9010	19.8954	19.7425	19.1246	18.2508	17.5273	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.9962	18.3070	18.8226	19.4453	19.8827	20.1108	20.1693	20.1621	20.0093	19.4244	18.6144	17.9474	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8462	18.1570	18.6726	19.2953	19.7327	19.9608	20.0193	20.0121	19.8593	19.2744	18.4644	17.7974	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9237	0.8768	0.7849	0.6482	0.4765	0.3312	0.3751	0.6091	0.8304	0.9234	0.9532	(94)
Useful gains	619.1754	686.6814	742.9927	756.9028	675.2981	489.8876	324.7279	339.3220	494.8157	584.0577	586.2111	592.2489	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1356.8046	1324.0066	1212.2655	1021.4449	787.2951	519.2133	331.1702	349.0685	560.3763	850.1944	1119.5574	1346.6906	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	548.7961	428.2825	349.1389	190.4703	83.3258	0.0000	0.0000	0.0000	0.0000	198.0058	384.0094	561.3046	(98)
Space heating												2743.3334	(98)
Space heating per m2											(98) / (4) =	34.1550	(99)

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8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3031.3076	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	548.7961	428.2825	349.1389	190.4703	83.3258	0.0000	0.0000	0.0000	0.0000	198.0058	384.0094	561.3046	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	606.4045	473.2403	385.7889	210.4644	92.0727	0.0000	0.0000	0.0000	0.0000	218.7909	424.3197	620.2261	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7357	89.6658	89.5081	89.1549	88.5293	87.3000	87.3000	87.3000	87.3000	89.1561	89.5811	89.7655	(217)
Fuel for water heating, kWh/month													
	185.1130	162.4740	169.0162	149.4509	145.5476	129.0595	121.2740	136.7748	137.7020	155.1149	166.5681	179.7124	(219)
Water heating fuel used												1837.8074	(219)
Annual totals kWh/year													
Space heating fuel - main system												3031.3076	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5295.1610	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3031.3076	3.4800	105.4895	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1837.8074	3.4800	63.9557	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Total energy cost			345.6407	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1584	(257)
SAP value		83.8405	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3031.3076	0.2160	654.7624	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1837.8074	0.2160	396.9664	(264)
Space and water heating			1051.7288	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1272.8468	(272)
CO2 emissions per m2			15.8500	(273)
EI value			86.3899	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	11.9814	0.4600	0.0000	0.7700	10.4822	(74)
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	111.8853	196.6193	320.5842	485.5148	584.6116	643.2522	604.6081	527.1755	405.1662	249.1579	142.8116	91.2125	(83)
Total gains	667.3696	747.8047	850.4681	982.3184	1047.5251	1075.7551	1019.2840	950.0413	847.0150	724.2990	654.9959	631.4425	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9620	0.9447	0.8997	0.7980	0.6393	0.4275	0.2884	0.3169	0.5885	0.8430	0.9389	0.9670	(86)
MIT	19.4466	19.6498	20.0484	20.5065	20.8232	20.9670	20.9936	20.9913	20.9017	20.4970	19.9118	19.4131	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9544	0.9339	0.8798	0.7599	0.5757	0.3424	0.1900	0.2131	0.5005	0.8029	0.9246	0.9602	(89)
MIT 2	17.8850	18.1776	18.7396	19.3627	19.7536	19.9057	19.9218	19.9247	19.8528	19.3722	18.5644	17.8431	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2762	18.5464	19.0675	19.6493	20.0215	20.1715	20.1903	20.1919	20.1155	19.6539	18.9019	18.2364	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1262	18.3964	18.9175	19.4993	19.8715	20.0215	20.0403	20.0419	19.9655	19.5039	18.7519	18.0864	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9139	0.8575	0.7431	0.5728	0.3503	0.2008	0.2244	0.5040	0.7844	0.9043	0.9443	(94)
Useful gains	625.4665	683.4240	729.2482	729.9831	599.9801	376.8089	204.6702	213.2011	426.9037	568.1240	592.3074	596.2952	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1273.5514	1245.0852	1120.6463	927.6679	664.0608	385.4223	205.5325	214.4481	456.7228	760.5799	1034.6349	1257.7845	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	482.1752	377.4363	291.2002	142.3330	47.6761	0.0000	0.0000	0.0000	0.0000	143.1872	318.4758	492.1480	(98)
Space heating												2294.6319	(98)
Space heating per m2											(98) / (4) =	28.5686	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2535.5048	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	482.1752	377.4363	291.2002	142.3330	47.6761	0.0000	0.0000	0.0000	0.0000	143.1872	318.4758	492.1480	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	532.7903	417.0567	321.7682	157.2741	52.6808	0.0000	0.0000	0.0000	0.0000	158.2179	351.9070	543.8099	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6579	89.5855	89.3799	88.9240	88.1417	87.3000	87.3000	87.3000	87.3000	88.8990	89.4539	89.6884	(217)
Fuel for water heating, kWh/month													
	185.2736	162.6196	169.2587	149.8389	146.1877	129.0595	121.2740	136.7748	137.7020	155.5635	166.8051	179.8667	(219)
Water heating fuel used												1840.2241	(219)
Annual totals kWh/year													
Space heating fuel - main system												2535.5048	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												4801.7751	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2535.5048	3.9200	99.3918	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.2241	3.9200	72.1368	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Total energy cost			331.7860	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2535.5048	0.2160	547.6690	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.2241	0.2160	397.4884	(264)
Space and water heating			945.1575	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1166.2754	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2535.5048	1.2200	3093.3159	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.2241	1.2200	2245.0734	(264)
Space and water heating			5338.3893	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Primary energy kWh/year			6646.3509	(272)
Primary energy kWh/m2/year			82.7484	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (15.6%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (96.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£72	£81	-£8
Mains gas	£260	£222	£38
Space heating	£200	£200	£0
Water heating	£72	£43	£29
Lighting	£60	£60	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£332	-£6	£339
Total cost of uses	£332	-£6	£338
Delivered energy	60 kWh/m²	26 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	0 kg/m²	14 kg/m²
Primary energy	83 kWh/m²	0 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Energy content (annual)                                                                                  Total = Sum(45)m =   1460.6794 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.7162    19.8677    20.5017    17.8739    17.1504    14.7995    13.7139    15.7369    15.9249    18.5589    20.2585    21.9994 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6712    13.2321    14.6052    14.0835    14.5162    14.0056    14.4461    14.4916    14.0481    14.5684    14.1570    14.6569 (61)
Total heat required for water heating calculated for each month
              166.1124   145.6836   151.2832   133.2428   128.8524   112.6690   105.8722   119.4044   120.2139   138.2944   149.2136   161.3196 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1079.5246 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1813.6014 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.2416 (H8)
Utilisation factor                                                                                                                    0.5531 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               92.8365 (H14)
Volume ratio Veff/V                                                                                                                   0.8079 (H15)
Solar storage volume factor                                                                                                           0.9573 (H16)
Solar input                                                                                                                        -844.3736 (H17)
Solar input    -24.4852   -40.8587   -69.5870   -93.2603  -115.2152  -113.2749  -111.7780   -97.6610   -76.4881   -52.2324   -29.0429   -20.4899 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -844.3736 (63)
Output from w/h
              141.6273   104.8249    81.6962    39.9825    13.6371     0.0000     0.0000    21.7434    43.7257    86.0620   120.1707   140.8297 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =    794.2995 (64)
Heat gains from water heating, kWh/month
               54.0220    47.3481    49.0967    43.1413    41.6458    36.3070    34.0107    38.5064    38.8121    44.7810    48.4456    52.4296 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               49.6942    44.1380    35.8954    27.1751    20.3137    17.1497    18.5309    24.0871    32.3297    41.0499    47.9113    51.0754 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              328.5195   331.9285   323.3379   305.0496   281.9638   260.2665   245.7713   242.3623   250.9529   269.2413   292.3270   314.0243 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562 (71)
Water heating gains (Table 5)
               72.6102    70.4585    65.9902    59.9185    55.9756    50.4264    45.7133    51.7559    53.9058    60.1895    67.2855    70.4699 (72)
Total internal gains
              555.4843   551.1854   529.8840   496.8036   462.9135   432.5030   414.6759   422.8658   441.8488   475.1411   512.1843   540.2300 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.4700	10.6334	0.4600	0.0000	0.7700	9.3029	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

```
Solar gains     98.4863   192.2399   317.5230   467.5539   578.9032   595.6730   565.8165   481.7413   370.4791   228.1761   122.6775    81.0954 (83)
Total gains    653.9706   743.4253   847.4070   964.3575  1041.8167  1028.1759   980.4924   904.6071   812.3279   703.3172   634.8618   621.3254 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                           21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            32.7677    32.8624    32.9558    33.4015    33.4863    33.8865    33.8865    33.9617    33.7312    33.4863    33.3153    33.1384
alpha           3.1845     3.1908     3.1971     3.2268     3.2324     3.2591     3.2591     3.2641     3.2487     3.2324     3.2210     3.2092
util living area
                0.9688     0.9523     0.9158     0.8363     0.7104     0.5508     0.4179     0.4656     0.6874     0.8821     0.9531     0.9730 (86)

MIT            19.2449    19.4785    19.8697    20.3500    20.7085    20.9086    20.9720    20.9601    20.8073    20.3214    19.7021    19.2042 (87)
Th 2           19.8826    19.8854    19.8882    19.9014    19.9038    19.9153    19.9153    19.9175    19.9109    19.9038    19.8988    19.8936 (88)
util rest of house
                0.9626     0.9430     0.8994     0.8050     0.6573     0.4730     0.3216     0.3660     0.6130     0.8519     0.9424     0.9677 (89)
MIT 2          17.5789    17.9155    18.4727    19.1429    19.6067    19.8441    19.9010    19.8954    19.7425    19.1246    18.2508    17.5273 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2505 (91)
MIT            17.9962    18.3070    18.8226    19.4453    19.8827    20.1108    20.1693    20.1621    20.0093    19.4244    18.6144    17.9474 (92)
Temperature adjustment                                                                                                               -0.1500
adjusted MIT   17.8462    18.1570    18.6726    19.2953    19.7327    19.9608    20.0193    20.0121    19.8593    19.2744    18.4644    17.7974 (93)
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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9237	0.8768	0.7849	0.6482	0.4765	0.3312	0.3751	0.6091	0.8304	0.9234	0.9532	(94)
Useful gains	619.1754	686.6814	742.9927	756.9028	675.2981	489.8876	324.7279	339.3220	494.8157	584.0577	586.2111	592.2489	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1356.8046	1324.0066	1212.2655	1021.4449	787.2951	519.2133	331.1702	349.0685	560.3763	850.1944	1119.5574	1346.6906	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	548.7961	428.2825	349.1389	190.4703	83.3258	0.0000	0.0000	0.0000	0.0000	198.0058	384.0094	561.3046	(98)
Space heating												2743.3334	(98)
Space heating per m2											(98) / (4) =	34.1550	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3031.3076	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	548.7961	428.2825	349.1389	190.4703	83.3258	0.0000	0.0000	0.0000	0.0000	198.0058	384.0094	561.3046	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	606.4045	473.2403	385.7889	210.4644	92.0727	0.0000	0.0000	0.0000	0.0000	218.7909	424.3197	620.2261	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8246	89.8524	89.8753	89.9281	90.0358	87.3000	87.3000	87.3000	87.3000	89.5060	89.7162	89.8395	(217)
Fuel for water heating, kWh/month	157.6709	116.6634	90.8995	44.4605	15.1463	0.0000	0.0000	24.9065	50.0868	96.1522	133.9454	156.7570	(219)
Water heating fuel used												886.6886	(219)

Annual totals kWh/year		
Space heating fuel - main system	3031.3076	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394	-1727.2394	(233)
Total delivered energy for all uses	2666.8029	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3031.3076	3.4800	105.4895	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.6886	3.4800	30.8568	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			91.3139	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3060	(257)
SAP value	95.7309	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3031.3076	0.2160	654.7624	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.6886	0.2160	191.5247	(264)
Space and water heating			846.2872	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			196.9179	(272)
CO2 emissions per m2			2.4500	(273)
EI value			97.8944	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                    Total = Sum(45)m =   1460.6794 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.7162    19.8677    20.5017    17.8739    17.1504    14.7995    13.7139    15.7369    15.9249    18.5589    20.2585    21.9994 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6712    13.2321    14.6052    14.0835    14.5162    14.0056    14.4461    14.4916    14.0481    14.5684    14.1570    14.6569 (61)
Total heat required for water heating calculated for each month
             166.1124   145.6836   151.2832   133.2428   128.8524   112.6690   105.8722   119.4044   120.2139   138.2944   149.2136   161.3196 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1140.0998 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           1915.3676 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3113 (H8)
Utilisation factor                                                                                                                  0.5336 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.8365 (H14)
Volume ratio Veff/V                                                                                                                 0.8079 (H15)
Solar storage volume factor                                                                                                         0.9573 (H16)
Solar input                                                                                                                      -860.2505 (H17)
Solar input    -26.4781   -39.7965   -67.0223   -92.6454  -111.5762  -117.4291  -114.6094  -102.3469   -79.8821   -54.3423   -32.1848   -21.9373 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -860.2505 (63)
Output from w/h
             139.6344   105.8871    84.2609    40.5974    17.2761     0.0000     0.0000    17.0575    40.3317    83.9521   117.0288   139.3824 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    785.4083 (64)
Heat gains from water heating, kWh/month
              54.0220    47.3481    49.0967    43.1413    41.6458    36.3070    34.0107    38.5064    38.8121    44.7810    48.4456    52.4296 (65)


-------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              49.6942    44.1380    35.8954    27.1751    20.3137    17.1497    18.5309    24.0871    32.3297    41.0499    47.9113    51.0754 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             328.5195   331.9285   323.3379   305.0496   281.9638   260.2665   245.7713   242.3623   250.9529   269.2413   292.3270   314.0243 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562 (71)
Water heating gains (Table 5)
              72.6102    70.4585    65.9902    59.9185    55.9756    50.4264    45.7133    51.7559    53.9058    60.1895    67.2855    70.4699 (72)
Total internal gains
             555.4843   551.1854   529.8840   496.8036   462.9135   432.5030   414.6759   422.8658   441.8488   475.1411   512.1843   540.2300 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------------------

[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2             Table 6a      Specific data    Specific data        factor                W
                                                           W/m2      or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
North                                  2.4700            11.9814           0.4600           0.0000           0.7700           10.4822 (74)
East                                   3.6300            22.3313           0.4600           0.0000           0.7700           28.7124 (76)
West                                   4.6800            22.3313           0.4600           0.0000           0.7700           37.0176 (80)
West                                   4.5100            22.3313           0.4600           0.0000           0.7700           35.6730 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains    111.8853   196.6193   320.5842   485.5148   584.6116   643.2522   604.6081   527.1755   405.1662   249.1579   142.8116    91.2125 (83)
Total gains    667.3696   747.8047   850.4681   982.3184  1047.5251  1075.7551  1019.2840   950.0413   847.0150   724.2990   654.9959   631.4425 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           33.5695    33.7312    33.7312    33.9617    33.9617    34.2453    34.1770    34.3118    34.2453    34.1069    34.1069    33.8865
alpha          3.2380     3.2487     3.2487     3.2641     3.2641     3.2830     3.2785     3.2875     3.2830     3.2738     3.2738     3.2591
util living area
               0.9620     0.9447     0.8997     0.7980     0.6393     0.4275     0.2884     0.3169     0.5885     0.8430     0.9389     0.9670 (86)

MIT           19.4466    19.6498    20.0484    20.5065    20.8232    20.9670    20.9936    20.9913    20.9017    20.4970    19.9118    19.4131 (87)
Th 2          19.9062    19.9109    19.9109    19.9175    19.9175    19.9254    19.9235    19.9273    19.9254    19.9216    19.9216    19.9153 (88)
util rest of house
               0.9544     0.9339     0.8798     0.7599     0.5757     0.3424     0.1900     0.2131     0.5005     0.8029     0.9246     0.9602 (89)
MIT 2         17.8850    18.1776    18.7396    19.3627    19.7536    19.9057    19.9218    19.9247    19.8528    19.3722    18.5644    17.8431 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2505 (91)
MIT           18.2762    18.5464    19.0675    19.6493    20.0215    20.1715    20.1903    20.1919    20.1155    19.6539    18.9019    18.2364 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1262    18.3964    18.9175    19.4993    19.8715    20.0215    20.0403    20.0419    19.9655    19.5039    18.7519    18.0864 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9372	0.9139	0.8575	0.7431	0.5728	0.3503	0.2008	0.2244	0.5040	0.7844	0.9043	0.9443	(94)
Useful gains	625.4665	683.4240	729.2482	729.9831	599.9801	376.8089	204.6702	213.2011	426.9037	568.1240	592.3074	596.2952	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1273.5514	1245.0852	1120.6463	927.6679	664.0608	385.4223	205.5325	214.4481	456.7228	760.5799	1034.6349	1257.7845	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	482.1752	377.4363	291.2002	142.3330	47.6761	0.0000	0.0000	0.0000	0.0000	143.1872	318.4758	492.1480	(98)
Space heating												2294.6319	(98)
Space heating per m2											(98) / (4) =	28.5686	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2535.5048	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	482.1752	377.4363	291.2002	142.3330	47.6761	0.0000	0.0000	0.0000	0.0000	143.1872	318.4758	492.1480	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	532.7903	417.0567	321.7682	157.2741	52.6808	0.0000	0.0000	0.0000	0.0000	158.2179	351.9070	543.8099	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7611	89.7790	89.7616	89.7697	89.6262	87.3000	87.3000	87.3000	87.3000	89.2903	89.6173	89.7737	(217)
Fuel for water heating, kWh/month	155.5621	117.9419	93.8718	45.2239	19.2758	0.0000	0.0000	19.5389	46.1990	94.0215	130.5873	155.2596	(219)
Water heating fuel used												877.4819	(219)

Annual totals kWh/year		
Space heating fuel - main system	2535.5048	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	2064.8732	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2535.5048	3.9200	99.3918	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.4819	3.9200	34.3973	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-6.8510	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2535.5048	0.2160	547.6690	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.4819	0.2160	189.5361	(264)
Space and water heating			737.2051	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			37.5342	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2535.5048	1.2200	3093.3159	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.4819	1.2200	1070.5279	(264)
Space and water heating			4163.8438	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			25.1353	(272)
Primary energy kWh/m2/year			0.3129	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		274.07 (P1)
Transmission heat loss coefficient		58.47 (37)
Summer heat loss coefficient		332.54 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.4700	81.1852	0.4600	0.0000	0.9000	83.0183
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						706.6848

	Jun	Jul	Aug	
Solar gains	752	707	616	(P4)
Internal gains	430	412	420	
Total summer gains	1181	1118	1036	(P5)
Summer gain/loss ratio	3.55	3.36	3.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.52	22.23	21.89	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-346	**Issued on Date**	19/10/2022
Assessment Reference	Plot 346	**Prop Type Ref**	2-Opp-SEMI
Property	Plot 346, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	16.99	**TER**	18.65
Environmental	87 B	**% DER<TER**	8.90		
CO_2 Emissions (t/year)	1.14	**DFEE**	46.50	**TFEE**	54.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.97		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 3.63 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	505.7151	614.9882	732.6616	853.6760	930.0844	917.1096	875.8067	808.4848	721.3041	599.3001	505.0269	473.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9844	0.9707	0.9402	0.8715	0.7560	0.6006	0.4615	0.5117	0.7365	0.9172	0.9742	0.9873	(86)
MIT	19.0157	19.2909	19.7222	20.2437	20.6455	20.8821	20.9625	20.9474	20.7611	20.2012	19.5101	18.9711	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9812	0.9647	0.9277	0.8445	0.7055	0.5203	0.3577	0.4057	0.6647	0.8938	0.9679	0.9846	(89)
MIT 2	17.2491	17.6486	18.2683	19.0051	19.5353	19.8213	19.8957	19.8876	19.6963	18.9665	17.9785	17.1909	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6916	18.0600	18.6325	19.3154	19.8134	20.0870	20.1630	20.1530	19.9630	19.2758	18.3622	17.6368	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5416	17.9100	18.4825	19.1654	19.6634	19.9370	20.0130	20.0030	19.8130	19.1258	18.2122	17.4868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9708	0.9494	0.9068	0.8227	0.6930	0.5221	0.3675	0.4146	0.6574	0.8721	0.9537	0.9757	(94)
Useful gains	490.9349	583.8576	664.3911	702.3471	644.5632	478.7803	321.8245	335.1603	474.1780	522.6556	481.6212	461.4981	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1326.2917	1299.3356	1193.3260	1008.6767	780.5059	516.9093	330.5586	348.1962	555.8770	835.6239	1094.7154	1315.9311	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	621.5054	480.8012	393.5276	220.5573	101.1413	0.0000	0.0000	0.0000	0.0000	232.8484	441.4278	635.6982	(98)
Space heating												3127.5073	(98)
Space heating per m2											(98) / (4) =	38.9381	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3455.8091	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	621.5054	480.8012	393.5276	220.5573	101.1413	0.0000	0.0000	0.0000	0.0000	232.8484	441.4278	635.6982	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	686.7464	531.2721	434.8371	243.7097	111.7584	0.0000	0.0000	0.0000	0.0000	257.2910	487.7655	702.4289	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8057	89.7351	89.5881	89.2677	88.6789	87.3000	87.3000	87.3000	87.3000	89.2806	89.6696	89.8335	(217)
Fuel for water heating, kWh/month													
	184.9686	162.3484	168.8652	149.2620	145.3021	129.0595	121.2740	136.7748	137.7020	154.8986	166.4037	179.5762	(219)
Water heating fuel used												1836.4354	(219)
Annual totals kWh/year													
Space heating fuel - main system												3455.8091	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5718.2906	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3455.8091	0.2160	746.4548	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4354	0.2160	396.6700	(264)
Space and water heating			1143.1248	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/year			1364.2427	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.9900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.4483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.4483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	500.0642	593.7955	692.8516	793.6555	855.9201	841.1749	803.6437	746.9976	673.9401	572.3114	495.0572	470.3029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9976	0.9942	0.9833	0.9447	0.8463	0.6737	0.5085	0.5643	0.8197	0.9705	0.9950	0.9982	(86)
MIT	19.6866	19.8647	20.1545	20.5211	20.8062	20.9543	20.9906	20.9848	20.8791	20.4879	20.0188	19.6596	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9968	0.9922	0.9773	0.9247	0.7941	0.5803	0.3908	0.4429	0.7413	0.9560	0.9929	0.9976	(89)
MIT 2	18.1612	18.4227	18.8441	19.3702	19.7406	19.9075	19.9335	19.9330	19.8383	19.3362	18.6580	18.1296	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9893	0.9719	0.9187	0.7986	0.6020	0.4204	0.4734	0.7552	0.9506	0.9903	0.9965	(94)
Useful gains	497.7192	587.4441	673.3627	729.0980	683.5541	506.3781	337.8680	353.6432	508.9453	544.0125	490.2700	468.6384	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1395.7710	1356.5581	1234.6029	1033.8842	796.2859	527.4303	340.7500	358.6984	570.7523	865.0223	1146.4932	1386.5926	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating												3300.1463	(98)
Space heating per m2											(98) / (4) =	41.0875	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3533.3472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.3646	553.3668	447.0692	234.9530	89.7992	0.0000	0.0000	0.0000	0.0000	255.7080	505.8679	731.2184	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8315	87.5811	87.0397	85.7848	83.5252	80.3000	80.3000	80.3000	80.3000	85.8781	87.3264	87.9183	(217)
Fuel for water heating, kWh/month													
	230.4413	202.9497	212.4694	191.2064	190.1295	174.1812	166.8789	186.0308	188.0853	200.2614	210.2295	224.7787	(219)
Water heating fuel used												2377.6422	(219)
Annual totals kWh/year													
Space heating fuel - main system												3533.3472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6337.0355	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3533.3472	0.2160	763.2030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.6422	0.2160	513.5707	(264)
Space and water heating			1276.7737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1497.8916	(272)
Emissions per m2 for space and water heating			15.8961	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8961 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	473.3592	583.4135	702.7091	825.9260	903.7654	892.8026	853.2064	783.6939	695.7320	571.4490	474.6018	441.4329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9871	0.9746	0.9460	0.8800	0.7670	0.6123	0.4720	0.5249	0.7508	0.9259	0.9782	0.9896	(86)
MIT	18.9640	19.2429	19.6814	20.2146	20.6286	20.8751	20.9600	20.9433	20.7460	20.1662	19.4630	18.9199	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9843	0.9692	0.9345	0.8543	0.7173	0.5317	0.3665	0.4172	0.6802	0.9043	0.9728	0.9873	(89)
MIT 2	18.0334	18.3112	18.7433	19.2633	19.6389	19.8469	19.9009	19.8953	19.7537	19.2318	18.5417	17.9976	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2665	18.5446	18.9783	19.5016	19.8868	20.1045	20.1662	20.1578	20.0023	19.4659	18.7725	18.2286	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2665	18.5446	18.9783	19.5016	19.8868	20.1045	20.1662	20.1578	20.0023	19.4659	18.7725	18.2286	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9607	0.9227	0.8433	0.7165	0.5467	0.3919	0.4424	0.6868	0.8936	0.9652	0.9826	(94)
Useful gains	463.3161	560.4902	648.4026	696.5111	647.5258	488.1072	334.3800	346.7099	477.8524	510.6548	458.0934	433.7725	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1398.9009	1362.7145	1242.7012	1041.7155	802.4003	533.1280	345.4046	363.1543	574.2930	868.9562	1149.9110	1389.4046	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	696.0751	539.0947	442.1582	248.5472	115.2266	0.0000	0.0000	0.0000	0.0000	266.5762	498.1087	710.9903	(98)
Space heating												3516.7770	(98)
Space heating per m2											(98) / (4) =	43.7846	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	910.4273	716.7194	734.4609	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8418	0.8945	0.8696	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	766.4069	641.1320	638.6928	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.6896	1087.5076	1007.8281	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	265.8836	332.1034	274.6366	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												872.6236	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.4709	83.0259	68.6592	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												218.1559	(107)
Space cooling per m2												2.7161	(108)
Energy for space heating												43.7846	(99)
Energy for space cooling												2.7161	(108)
Total												46.5007	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	455.5149	550.2930	651.5922	755.2169	819.5359	807.4240	771.5905	712.1334	637.6670	533.1410	452.6973	426.5244	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9984	0.9958	0.9869	0.9534	0.8628	0.6949	0.5278	0.5883	0.8426	0.9775	0.9966	0.9989	(86)
MIT	19.6357	19.8157	20.1103	20.4867	20.7862	20.9477	20.9890	20.9818	20.8615	20.4481	19.9708	19.6093	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9979	0.9944	0.9821	0.9359	0.8135	0.6011	0.4065	0.4635	0.7683	0.9659	0.9952	0.9985	(89)
MIT 2	18.6634	18.8450	19.1392	19.5142	19.7841	19.9135	19.9342	19.9340	19.8569	19.4858	19.0109	18.6459	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9929	0.9791	0.9327	0.8192	0.6233	0.4372	0.4951	0.7824	0.9631	0.9939	0.9979	(94)
Useful gains	454.2309	546.3609	637.9664	704.3706	671.3454	503.2474	337.3349	352.5620	498.8992	513.4908	449.9441	425.6452	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1431.4050	1386.2859	1255.0688	1043.4237	798.9274	527.7029	340.7552	358.6991	571.6601	874.8184	1170.8186	1422.8601	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0175	564.4296	459.1242	244.1182	94.9210	0.0000	0.0000	0.0000	0.0000	268.8277	519.0296	741.9278	(98)
Space heating												3619.3957	(98)
Space heating per m2											(98) / (4) =	45.0622	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8876	0.9393	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	790.0736	658.2243	658.7034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.8965	992.1124	924.1859	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9925	248.4128	197.5189	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												622.9242	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   44.2481   62.1032   49.3797    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        155.7311 (107)
Space cooling per m2                                                                                                   1.9389 (108)
Energy for space heating                                                                                              45.0622 (99)
Energy for space cooling                                                                                               1.9389 (108)
Total                                                                                                                 47.0011 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                54.1 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)

Space heating 2190.3091 (98)
RHI space heating demand 2190 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833 (83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9647	0.9440	0.9031	0.8208	0.6966	0.5398	0.4070	0.4485	0.6604	0.8636	0.9459	0.9697	(86)
MIT	19.2919	19.5467	19.9356	20.3914	20.7256	20.9139	20.9741	20.9642	20.8294	20.3744	19.7539	19.2461	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6430	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6460	18.0117	18.5629	19.1957	19.6257	19.8486	19.9021	19.8978	19.7639	19.1928	18.3234	17.5873	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0583	18.3962	18.9067	19.4952	19.9012	20.1154	20.1706	20.1650	20.0308	19.4888	18.6817	18.0028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9083	18.2462	18.7567	19.3452	19.7512	19.9654	20.0206	20.0150	19.8808	19.3388	18.5317	17.8528	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9130	0.8618	0.7687	0.6348	0.4665	0.3222	0.3607	0.5833	0.8097	0.9138	0.9484	(94)
Useful gains	645.0927	723.6388	777.8252	778.0911	683.6470	492.0743	325.3593	340.6578	504.5980	610.8538	613.9852	615.3987	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1363.0212	1332.9153	1220.6415	1026.3498	789.1137	519.6630	331.3030	349.3476	562.4756	856.4989	1126.1903	1352.1836	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating												2629.9570	(98)
Space heating per m2											(98) / (4) =	32.7435	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2906.0298	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	590.2086	452.4131	364.0390	197.5097	86.7041	0.0000	0.0000	0.0000	0.0000	201.9446	407.5002	605.7104	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7199	89.6377	89.4680	89.1051	88.4842	87.3000	87.3000	87.3000	87.3000	89.0933	89.5544	89.7520	(217)
Fuel for water heating, kWh/month													
	185.1457	162.5248	169.0920	149.5344	145.6219	129.0595	121.2740	136.7748	137.7020	155.2243	166.6178	179.7394	(219)
Water heating fuel used												1838.3106	(219)
Annual totals kWh/year													
Space heating fuel - main system												2906.0298	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5170.3865	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.0298	3.4800	101.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.3106	3.4800	63.9732	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Total energy cost			341.2985	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1438	(257)
SAP value		84.0435	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2906.0298	0.2160	627.7024	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.3106	0.2160	397.0751	(264)
Space and water heating			1024.7775	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1245.8955	(272)
CO2 emissions per m2			15.5100	(273)
EI value			86.6781	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8867 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8867 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating												2190.3091	(98)
Space heating per m2											(98) / (4) =	27.2698	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.2310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	515.8749	397.6604	302.8182	147.0689	49.5429	0.0000	0.0000	0.0000	0.0000	143.9357	334.6058	528.7243	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6377	89.5541	89.3353	88.8703	88.1042	87.3000	87.3000	87.3000	87.3000	88.8234	89.4181	89.6713	(217)
Fuel for water heating, kWh/month													
	185.3153	162.6766	169.3432	149.9294	146.2500	129.0595	121.2740	136.7748	137.7020	155.6959	166.8719	179.9012	(219)
Water heating fuel used												1840.7938	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.2310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												4687.0709	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.2310	3.9200	94.8731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.7938	3.9200	72.1591	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Total energy cost			327.2896	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2420.2310	0.2160	522.7699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7938	0.2160	397.6115	(264)
Space and water heating			920.3814	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1141.4993	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2420.2310	1.2200	2952.6818	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7938	1.2200	2245.7684	(264)
Space and water heating			5198.4502	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Primary energy kWh/year			6506.4118	(272)
Primary energy kWh/m2/year			81.0061	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (15.9%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (98.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 89
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£72	£81	-£8
Mains gas	£255	£217	£38
Space heating	£196	£196	£0
Water heating	£72	£43	£29
Lighting	£60	£60	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£327	-£11	£339
Total cost of uses	£328	-£10	£338
Delivered energy	58 kWh/m²	24 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	81 kWh/m²	-1 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2416	(H8)
Utilisation factor												0.5531	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-844.3736	(H17)
Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899	(63)
											Solar input (sum of months) = Sum(63)m =	-844.3736	(63)
Output from w/h													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
											Total per year (kWh/year) = Sum(64)m =	794.2995	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9647	0.9440	0.9031	0.8208	0.6966	0.5398	0.4070	0.4485	0.6604	0.8636	0.9459	0.9697	(86)
MIT	19.2919	19.5467	19.9356	20.3914	20.7256	20.9139	20.9741	20.9642	20.8294	20.3744	19.7539	19.2461	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6430	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6460	18.0117	18.5629	19.1957	19.6257	19.8486	19.9021	19.8978	19.7639	19.1928	18.3234	17.5873	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.0583	18.3962	18.9067	19.4952	19.9012	20.1154	20.1706	20.1650	20.0308	19.4888	18.6817	18.0028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9083	18.2462	18.7567	19.3452	19.7512	19.9654	20.0206	20.0150	19.8808	19.3388	18.5317	17.8528	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9130	0.8618	0.7687	0.6348	0.4665	0.3222	0.3607	0.5833	0.8097	0.9138	0.9484	(94)
Useful gains	645.0927	723.6388	777.8252	778.0911	683.6470	492.0743	325.3593	340.6578	504.5980	610.8538	613.9852	615.3987	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1363.0212	1332.9153	1220.6415	1026.3498	789.1137	519.6630	331.3030	349.3476	562.4756	856.4989	1126.1903	1352.1836	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating												2629.9570	(98)
Space heating per m2											(98) / (4) =	32.7435	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2906.0298	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	590.2086	452.4131	364.0390	197.5097	86.7041	0.0000	0.0000	0.0000	0.0000	201.9446	407.5002	605.7104	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8101	89.8288	89.8456	89.8977	90.0115	87.3000	87.3000	87.3000	87.3000	89.4503	89.6920	89.8270	(217)
Fuel for water heating, kWh/month	157.6965	116.6940	90.9295	44.4755	15.1504	0.0000	0.0000	24.9065	50.0868	96.2121	133.9815	156.7789	(219)
Water heating fuel used												886.9117	(219)

Annual totals kWh/year		
Space heating fuel - main system	2906.0298	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394	-1727.2394	(233)
Total delivered energy for all uses	2541.7483	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.0298	3.4800	101.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9117	3.4800	30.8645	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			86.9620	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.2914	(257)
SAP value	95.9343	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2906.0298	0.2160	627.7024	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9117	0.2160	191.5729	(264)
Space and water heating			819.2754	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			169.9061	(272)
CO2 emissions per m2			2.1200	(273)
EI value			98.1833	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)
Total heat required for water heating calculated for each month												
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1140.0998 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1915.3676 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3113 (H8)
Utilisation factor	0.5336 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-860.2505 (H17)

Solar input	-26.4781	-39.7965	-67.0223	-92.6454	-111.5762	-117.4291	-114.6094	-102.3469	-79.8821	-54.3423	-32.1848	-21.9373 (63)
								Solar input (sum of months) = Sum(63)m =				-860.2505 (63)
Output from w/h												
	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824 (64)
								Total per year (kWh/year) = Sum(64)m =				785.4083 (64)
Heat gains from water heating, kWh/month												
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840 (83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating												2190.3091	(98)
Space heating per m2											(98) / (4) =	27.2698	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.2310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	515.8749	397.6604	302.8182	147.0689	49.5429	0.0000	0.0000	0.0000	0.0000	143.9357	334.6058	528.7243	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7427	89.7521	89.7266	89.7312	89.5866	87.3000	87.3000	87.3000	87.3000	89.2183	89.5847	89.7578	(217)
Fuel for water heating, kWh/month	155.5942	117.9773	93.9085	45.2433	19.2843	0.0000	0.0000	19.5389	46.1990	94.0973	130.6349	155.2872	(219)
Water heating fuel used												877.7648	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.2310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												1949.8823	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.2310	3.9200	94.8731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.7648	3.9200	34.4084	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-11.3586	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2420.2310	0.2160	522.7699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7648	0.2160	189.5972	(264)
Space and water heating			712.3671	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			12.6962	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2420.2310	1.2200	2952.6818	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7648	1.2200	1070.8731	(264)
Space and water heating			4023.5549	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-115.1536	(272)
Primary energy kWh/m2/year			-1.4337	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						738.4060

	Jun	Jul	Aug	
Solar gains	781	738	662	(P4)
Internal gains	430	412	420	
Total summer gains	1210	1150	1082	(P5)
Summer gain/loss ratio	3.64	3.46	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.61	22.33	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-347	**Issued on Date**	19/10/2022
Assessment Reference	Plot 347	**Prop Type Ref**	2-As-SEMI
Property	Plot 347, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	17.30	**TER**	18.91
Environmental	86 B	**% DER<TER**	8.53		
CO_2 Emissions (t/year)	1.16	**DFEE**	47.36	**TFEE**	54.92
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.76		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.91 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.30 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 0.82 m², No overhang
Windows facing East: 3.63 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.4124	(36)
Total fabric heat loss	(33) + (36) = 56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	98.2070	97.9183	97.6354	96.3063	96.0576	94.9000	94.9000	94.6856	95.3459	96.0576	96.5606	97.0866	(39)
Average = Sum(39)m / 12 =												96.3051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2191	1.2156	1.1990	1.1959	1.1815	1.1815	1.1789	1.1871	1.1959	1.2022	1.2087	(40)
HLP (average)												1.1990	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.9940	373.8631	360.2816	338.4046	316.1994	294.8241	280.9619	286.9838	298.2468	320.3358	345.6941	364.7045	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	468.2658	554.2268	657.6241	773.5434	851.4364	843.7512	803.1352	734.0997	644.4624	534.3748	460.7052	440.6192	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6637	33.7630	33.8608	34.3281	34.4170	34.8368	34.8368	34.9157	34.6739	34.4170	34.2377	34.0522	
alpha	3.2442	3.2509	3.2574	3.2885	3.2945	3.3225	3.3225	3.3277	3.3116	3.2945	3.2825	3.2701	
util living area													
	0.9877	0.9781	0.9542	0.8944	0.7852	0.6306	0.4897	0.5459	0.7759	0.9365	0.9802	0.9899	(86)
MIT	19.0082	19.2486	19.6642	20.1942	20.6171	20.8713	20.9585	20.9404	20.7305	20.1507	19.4853	18.9714	(87)
Th 2	19.9019	19.9047	19.9076	19.9208	19.9233	19.9348	19.9348	19.9370	19.9304	19.9233	19.9182	19.9130	(88)
util rest of house													
	0.9851	0.9734	0.9442	0.8709	0.7376	0.5506	0.3830	0.4374	0.7084	0.9174	0.9752	0.9877	(89)
MIT 2	17.2487	17.5991	18.1995	18.9543	19.5193	19.8304	19.9126	19.9023	19.6819	18.9119	17.9542	17.2018	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6894	18.0123	18.5664	19.2649	19.7943	20.0911	20.1746	20.1623	19.9446	19.2222	18.3378	17.6451	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5394	17.8623	18.4164	19.1149	19.6443	19.9411	20.0246	20.0123	19.7946	19.0722	18.1878	17.4951	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9764	0.9607	0.9257	0.8493	0.7235	0.5511	0.3925	0.4456	0.6985	0.8972	0.9632	0.9802	(94)
Useful gains	457.2144	532.4685	608.7359	657.0007	616.0324	465.0236	315.2257	327.1026	450.1494	479.4603	443.7683	431.8958	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1300.2046	1269.2504	1163.4648	983.7596	763.1114	506.8749	324.9984	342.0361	542.9547	813.8233	1070.6406	1290.7736	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.1847	495.1174	412.7183	235.2664	109.4268	0.0000	0.0000	0.0000	0.0000	248.7661	451.3481	639.0051	(98)
Space heating												3218.8328	(98)
Space heating per m2											(98) / (4) =	40.0751	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3556.7214	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	627.1847	495.1174	412.7183	235.2664	109.4268	0.0000	0.0000	0.0000	0.0000	248.7661	451.3481	639.0051	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	693.0218	547.0910	456.0423	259.9629	120.9136	0.0000	0.0000	0.0000	0.0000	274.8797	498.7272	706.0829	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8107	89.7521	89.6189	89.3162	88.7410	87.3000	87.3000	87.3000	87.3000	89.3301	89.6832	89.8362	(217)
Fuel for water heating, kWh/month													
	184.9585	162.3178	168.8073	149.1809	145.2005	129.0595	121.2740	136.7748	137.7020	154.8128	166.3785	179.5708	(219)
Water heating fuel used												1836.0373	(219)
Annual totals kWh/year													
Space heating fuel - main system												3556.7214	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	357.4827	(232)
Total delivered energy for all uses	5825.2414	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3556.7214	0.2160	768.2518	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.0373	0.2160	396.5841	(264)
Space and water heating			1164.8359	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Total CO2, kg/year			1389.2944	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.3000	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.7583	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.7583	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.6400	1.3258	18.0833			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.1800	13.8474			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5023			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.5511	(36)
Total fabric heat loss					(33) + (36) =		54.0534	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	95.7275	95.4395	95.1573	93.8315	93.5835	92.4288	92.4288	92.2150	92.8736	93.5835	94.0853	94.6099	(39)
Average = Sum(39)m / 12 =												93.8303	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1918	1.1882	1.1847	1.1682	1.1651	1.1508	1.1508	1.1481	1.1563	1.1651	1.1714	1.1779	(40)
HLP (average)												1.1682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4689	(42)
Average daily hot water use (litres/day)												92.8365	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	388.1874	385.7909	371.5886	349.0932	326.2645	304.2681	290.4147	297.0571	308.9477	331.6551	357.6289	376.9027	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.6300	0.7000	0.7700	2.6648	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	79.6145	155.6225	256.5549	375.4491	461.8165	473.6286	450.5447	385.7833	298.7239	184.6785	99.2346	65.5012	(83)
Total gains	467.8019	541.4134	628.1434	724.5423	788.0810	777.8967	740.9594	682.8405	607.6716	516.3335	456.8635	442.4039	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2673	58.4431	58.6164	59.4446	59.6022	60.3467	60.3467	60.4867	60.0577	59.6022	59.2843	58.9556	
alpha	4.8845	4.8962	4.9078	4.9630	4.9735	5.0231	5.0231	5.0324	5.0038	4.9735	4.9523	4.9304	
util living area													
	0.9982	0.9961	0.9884	0.9582	0.8711	0.7035	0.5364	0.5985	0.8548	0.9795	0.9964	0.9987	(86)
MIT	19.6868	19.8420	20.1182	20.4859	20.7856	20.9482	20.9892	20.9819	20.8582	20.4548	20.0070	19.6649	(87)
Th 2	19.9265	19.9294	19.9322	19.9455	19.9480	19.9596	19.9596	19.9617	19.9551	19.9480	19.9430	19.9377	(88)
util rest of house													
	0.9976	0.9947	0.9842	0.9423	0.8238	0.6112	0.4160	0.4746	0.7840	0.9689	0.9950	0.9982	(89)
MIT 2	18.1773	18.4058	18.8091	19.3418	19.7386	19.9254	19.9557	19.9543	19.8399	19.3083	18.6571	18.1532	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.5554	18.7656	19.1370	19.6284	20.0008	20.1816	20.2146	20.2117	20.0950	19.5955	18.9952	18.5319	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5554	18.7656	19.1370	19.6284	20.0008	20.1816	20.2146	20.2117	20.0950	19.5955	18.9952	18.5319	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9925	0.9798	0.9362	0.8265	0.6322	0.4463	0.5058	0.7950	0.9641	0.9930	0.9973	(94)
Useful gains	466.1519	537.3689	615.4815	678.3389	651.3852	491.7871	330.7047	345.3521	483.0919	497.7775	453.6493	441.2109	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1364.6363	1323.3232	1202.5065	1006.6588	776.8213	515.9017	334.0889	351.4970	556.7733	841.8327	1119.1658	1355.9348	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.4724	528.1613	436.7465	236.3903	93.3245	0.0000	0.0000	0.0000	0.0000	255.9771	479.1719	680.5545	(98)
Space heating												3378.7985	(98)
Space heating per m2											(98) / (4) =	42.0667	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3617.5573	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.4724	528.1613	436.7465	236.3903	93.3245	0.0000	0.0000	0.0000	0.0000	255.9771	479.1719	680.5545	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.7092	565.4832	467.6087	253.0946	99.9191	0.0000	0.0000	0.0000	0.0000	274.0654	513.0320	728.6451	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8325	87.6249	87.1396	85.9705	83.7640	80.3000	80.3000	80.3000	80.3000	86.0505	87.3564	87.9117	(217)
Fuel for water heating, kWh/month													
	230.4389	202.8482	212.2257	190.7933	189.5874	174.1812	166.8789	186.0308	188.0853	199.8601	210.1573	224.7956	(219)
Water heating fuel used												2375.8828	(219)
Annual totals kWh/year													
Space heating fuel - main system												3617.5573	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Total delivered energy for all uses												6425.9228	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3617.5573	0.2160	781.3924	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2375.8828	0.2160	513.1907	(264)
Space and water heating			1294.5831	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Total CO2, kg/m2/year			1519.0416	(272)
Emissions per m2 for space and water heating			16.1178	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3099	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1178 * 1.00) + 2.3099 + 0.4846, rounded to 2 d.p.			18.9100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.4124	(36)
Total fabric heat loss	(33) + (36) = 56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	98.2070	97.9183	97.6354	96.3063	96.0576	94.9000	94.9000	94.6856	95.3459	96.0576	96.5606	97.0866	(39)
Average = Sum(39)m / 12 =												96.3051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2191	1.2156	1.1990	1.1959	1.1815	1.1815	1.1789	1.1871	1.1959	1.2022	1.2087	(40)
HLP (average)												1.1990	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.6381	342.2884	330.3291	310.6547	289.8803	270.5172	258.3616	262.1929	272.6747	292.4847	315.2690	333.1242	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	435.9099	522.6521	627.6716	745.7934	825.1174	819.4443	780.5348	709.3088	618.8903	506.5237	430.2802	409.0389	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6637	33.7630	33.8608	34.3281	34.4170	34.8368	34.8368	34.9157	34.6739	34.4170	34.2377	34.0522	
alpha	3.2442	3.2509	3.2574	3.2885	3.2945	3.3225	3.3225	3.3277	3.3116	3.2945	3.2825	3.2701	
util living area													
	0.9900	0.9814	0.9594	0.9027	0.7966	0.6435	0.5016	0.5608	0.7910	0.9444	0.9836	0.9918	(86)
MIT	18.9558	19.1993	19.6213	20.1624	20.5979	20.8631	20.9555	20.9354	20.7125	20.1131	19.4372	18.9197	(87)
Th 2	19.9019	19.9047	19.9076	19.9208	19.9233	19.9348	19.9348	19.9370	19.9304	19.9233	19.9182	19.9130	(88)
util rest of house													
	0.9878	0.9773	0.9503	0.8805	0.7501	0.5634	0.3932	0.4508	0.7253	0.9273	0.9794	0.9901	(89)
MIT 2	18.0385	18.2820	18.7000	19.2320	19.6320	19.8585	19.9184	19.9110	19.7476	19.1977	18.5300	18.0106	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.2683	18.5118	18.9308	19.4650	19.8740	20.1101	20.1782	20.1676	19.9893	19.4270	18.7572	18.2383	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2683	18.5118	18.9308	19.4650	19.8740	20.1101	20.1782	20.1676	19.9893	19.4270	18.7572	18.2383	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9833	0.9705	0.9400	0.8694	0.7478	0.5775	0.4191	0.4762	0.7294	0.9172	0.9733	0.9863	(94)
Useful gains	428.6420	507.2164	590.0233	648.3891	616.9911	473.2469	327.1544	337.7631	451.4260	464.5771	418.7784	403.4154	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1371.7837	1332.8439	1213.6852	1017.4789	785.1743	522.9123	339.5730	356.7421	561.5207	847.9028	1125.6282	1362.9338	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	701.6975	554.8216	464.0045	265.7446	125.1284	0.0000	0.0000	0.0000	0.0000	285.1943	508.9319	713.8817	(98)
Space heating												3619.4044	(98)
Space heating per m2											(98) / (4) =	45.0623	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	892.0599	702.2600	719.6107	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8270	0.8832	0.8535	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	737.7120	620.2246	614.1522	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1050.1136	1002.7477	921.1196	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	224.9292	284.5972	228.3838	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												737.9101	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	56.2323	71.1493	57.0960	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												184.4775	(107)
Space cooling per m2												2.2968	(108)
Energy for space heating												45.0623	(99)
Energy for space cooling												2.2968	(108)
Total												47.3591	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.6400	1.3258	18.0833			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.1800	13.8474			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5023			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.5511	(36)
Total fabric heat loss (33) + (36) =	54.0534	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	95.7275	95.4395	95.1573	93.8315	93.5835	92.4288	92.4288	92.2150	92.8736	93.5835	94.0853	94.6099	(39)
Average = Sum(39)m / 12 =												93.8303	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1918	1.1882	1.1847	1.1682	1.1651	1.1508	1.1508	1.1481	1.1563	1.1651	1.1714	1.1779	(40)
HLP (average)												1.1682	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2422	17.9789	14.6214	11.0694	8.2745	6.9857	7.5483	9.8115	13.1690	16.7210	19.5159	20.8047	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.6381	342.2884	330.3291	310.6547	289.8803	270.5172	258.3616	262.1929	272.6747	292.4847	315.2690	333.1242	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.6300	0.7000	0.7700	2.6648	(74)
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	79.6145	155.6225	256.5549	375.4491	461.8165	473.6286	450.5447	385.7833	298.7239	184.6785	99.2346	65.5012	(83)
Total gains	423.2526	497.9109	586.8840	686.1038	751.6968	744.1458	708.9063	647.9762	571.3985	477.1632	414.5036	398.6254	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2673	58.4431	58.6164	59.4446	59.6022	60.3467	60.3467	60.4867	60.0577	59.6022	59.2843	58.9556	
alpha	4.8845	4.8962	4.9078	4.9630	4.9735	5.0231	5.0231	5.0324	5.0038	4.9735	4.9523	4.9304	
util living area													
	0.9989	0.9973	0.9913	0.9658	0.8872	0.7262	0.5581	0.6256	0.8774	0.9851	0.9977	0.9992	(86)
MIT	19.6355	19.7923	20.0728	20.4491	20.7628	20.9402	20.9871	20.9780	20.8371	20.4132	19.9584	19.6143	(87)
Th 2	19.9265	19.9294	19.9322	19.9455	19.9480	19.9596	19.9596	19.9617	19.9551	19.9480	19.9430	19.9377	(88)
util rest of house													
	0.9985	0.9963	0.9880	0.9523	0.8434	0.6342	0.4341	0.4986	0.8121	0.9771	0.9967	0.9989	(89)
MIT 2	18.6811	18.8399	19.1208	19.4991	19.7872	19.9322	19.9563	19.9554	19.8620	19.4716	19.0168	18.6688	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9202	19.0785	19.3593	19.7371	20.0316	20.1847	20.2146	20.2116	20.1063	19.7074	19.2527	18.9056	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9202	19.0785	19.3593	19.7371	20.0316	20.1847	20.2146	20.2116	20.1063	19.7074	19.2527	18.9056	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9953	0.9857	0.9490	0.8474	0.6556	0.4655	0.5307	0.8233	0.9746	0.9958	0.9985	(94)
Useful gains	422.3944	495.5496	578.4803	651.0838	637.0207	487.8768	330.0092	343.8913	470.4103	465.0543	412.7629	398.0259	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1399.5508	1353.1845	1223.6557	1016.8592	779.7014	516.1846	334.0887	351.4852	557.8223	852.3059	1143.3863	1391.2962	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0044	576.3306	480.0105	263.3582	106.1544	0.0000	0.0000	0.0000	0.0000	288.1152	526.0489	738.9931	(98)
Space heating												3706.0153	(98)
Space heating per m2											(98) / (4) =	46.1406	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	868.8309	683.9733	700.8339	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8734	0.9302	0.9032	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	758.8619	636.2480	632.9809	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	962.1024	919.0260	849.4321	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	146.3332	210.3868	161.0397	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												517.7597	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	36.5833	52.5967	40.2599	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												129.4399 (107)
Space cooling per m2												1.6116 (108)
Energy for space heating												46.1406 (99)
Energy for space cooling												1.6116 (108)
Total												47.7522 (109)
Target Fabric Energy Efficiency (TFEE)												54.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124 (36)
Total fabric heat loss	(33) + (36) =	56.5142 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	95.8146	95.3459	95.3459	94.6856	94.6856	93.8853	94.0768	93.6995	93.8853	94.2740	94.2740	94.9000	(39)
Average = Sum(39)m / 12 =												94.5727	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1929	1.1871	1.1871	1.1789	1.1789	1.1689	1.1713	1.1666	1.1689	1.1737	1.1737	1.1815	(40)
HLP (average)												1.1774	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	11.9814	0.4600	0.0000	0.7700	3.4799	(74)
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	104.8830	184.4708	299.9826	451.2647	539.7261	591.9205	557.1610	488.5972	378.2455	233.6507	133.9392	85.4457 (83)
Total gains	661.2785	736.4654	830.5247	948.5666	1003.0121	1024.7379	972.1767	911.9047	820.6871	709.5445	647.0020	626.6122 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5043	34.6739	34.6739	34.9157	34.9157	35.2133	35.1416	35.2831	35.2133	35.0681	35.0681	34.8368	
alpha	3.3003	3.3116	3.3116	3.3277	3.3277	3.3476	3.3428	3.3522	3.3476	3.3379	3.3379	3.3225	
util living area	0.9630	0.9465	0.9037	0.8067	0.6519	0.4393	0.2962	0.3235	0.5955	0.8466	0.9403	0.9677	(86)
MIT	19.4883	19.6831	20.0674	20.5109	20.8227	20.9669	20.9937	20.9916	20.9043	20.5108	19.9424	19.4567	(87)
Th 2	19.9257	19.9304	19.9304	19.9370	19.9370	19.9450	19.9430	19.9468	19.9450	19.9411	19.9411	19.9348	(88)
util rest of house	0.9555	0.9360	0.8845	0.7697	0.5891	0.3537	0.1970	0.2195	0.5083	0.8073	0.9264	0.9611	(89)
MIT 2	17.9563	18.2372	18.7796	19.3848	19.7716	19.9250	19.9413	19.9443	19.8738	19.4052	18.6200	17.9172	(90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.3401	18.5994	19.1022	19.6669	20.0349	20.1860	20.2049	20.2067	20.1319	19.6821	18.9512	18.3028	(92)

Temperature adjustment -0.1500

adjusted MIT	18.1901	18.4494	18.9522	19.5169	19.8849	20.0360	20.0549	20.0567	19.9819	19.5321	18.8012	18.1528	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9389	0.9168	0.8628	0.7530	0.5858	0.3613	0.2077	0.2305	0.5116	0.7892	0.9067	0.9458	(94)
Useful gains	620.8961	675.1848	716.5931	714.2491	587.5228	370.2632	201.8797	210.2382	419.8433	560.0045	586.6455	592.6537	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.2209	1225.1375	1101.4518	910.5825	651.9010	378.9224	202.7308	211.4504	448.9510	747.7952	1018.2768	1238.7118	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	471.1937	369.5682	286.3349	141.3601	47.8974	0.0000	0.0000	0.0000	0.0000	139.7163	310.7746	480.6672	(98)

Space heating 2247.5123 (98)
RHI space heating demand 2248 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124	(36)
Total fabric heat loss	(33) + (36) =	56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	98.2070	97.9183	97.6354	96.3063	96.0576	94.9000	94.9000	94.6856	95.3459	96.0576	96.5606	97.0866	(39)
Average = Sum(39)m / 12 =												96.3051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2191	1.2156	1.1990	1.1959	1.1815	1.1815	1.1789	1.1871	1.1959	1.2022	1.2087	(40)
HLP (average)												1.1990	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	648.6673	732.3584	827.8846	932.4407	998.5231	981.7445	937.1889	870.4234	788.6572	689.9329	628.0739	617.0812	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6637	33.7630	33.8608	34.3281	34.4170	34.8368	34.8368	34.9157	34.6739	34.4170	34.2377	34.0522	
alpha	3.2442	3.2509	3.2574	3.2885	3.2945	3.3225	3.3225	3.3277	3.3116	3.2945	3.2825	3.2701	
util living area													
	0.9696	0.9539	0.9195	0.8441	0.7228	0.5639	0.4282	0.4741	0.6943	0.8852	0.9542	0.9737	(86)
MIT	19.2897	19.5137	19.8908	20.3561	20.7076	20.9081	20.9722	20.9609	20.8116	20.3386	19.7366	19.2510	(87)
Th 2	19.9019	19.9047	19.9076	19.9208	19.9233	19.9348	19.9348	19.9370	19.9304	19.9233	19.9182	19.9130	(88)
util rest of house													
	0.9636	0.9450	0.9037	0.8138	0.6707	0.4863	0.3316	0.3747	0.6210	0.8557	0.9438	0.9685	(89)
MIT 2	17.6544	17.9775	18.5153	19.1666	19.6234	19.8627	19.9204	19.9151	19.7649	19.1618	18.3117	17.6057	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0641	18.3623	18.8599	19.4645	19.8950	20.1246	20.1839	20.1771	20.0271	19.4566	18.6686	18.0178	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9141	18.2123	18.7099	19.3145	19.7450	19.9746	20.0339	20.0271	19.8771	19.3066	18.5186	17.8678	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9483	0.9264	0.8818	0.7940	0.6612	0.4894	0.3409	0.3835	0.6169	0.8349	0.9254	0.9545	(94)
Useful gains	615.1481	678.4662	730.0328	740.3266	660.2461	480.4782	319.4529	333.8425	486.5369	576.0088	581.2508	589.0186	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1336.9953	1303.5211	1192.1150	1002.9857	772.7838	510.0452	325.8764	343.4300	550.8195	836.3333	1102.5904	1326.9647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	537.0543	420.0369	343.7892	189.1145	83.7280	0.0000	0.0000	0.0000	0.0000	193.6815	375.3645	549.0319	(98)
Space heating												2691.8008	(98)
Space heating per m2											(98) / (4) =	33.5135	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2974.3655	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	537.0543	420.0369	343.7892	189.1145	83.7280	0.0000	0.0000	0.0000	0.0000	193.6815	375.3645	549.0319	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	593.4302	464.1291	379.8775	208.9663	92.5171	0.0000	0.0000	0.0000	0.0000	214.0127	414.7674	606.6650	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7231	89.6537	89.4975	89.1493	88.5330	87.3000	87.3000	87.3000	87.3000	89.1389	89.5661	89.7529	(217)
Fuel for water heating, kWh/month													
	185.1391	162.4958	169.0362	149.4602	145.5416	129.0595	121.2740	136.7748	137.7020	155.1449	166.5960	179.7376	(219)
Water heating fuel used												1837.9617	(219)
Annual totals kWh/year													
Space heating fuel - main system												2974.3655	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Total delivered energy for all uses												5244.8099	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2974.3655	3.4800	103.5079	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1837.9617	3.4800	63.9611	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	357.4827	13.1900	47.1520	(250)
Additional standing charges			120.0000	(251)
Total energy cost			344.5135	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1546	(257)
SAP value		83.8932	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2974.3655	0.2160	642.4629	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1837.9617	0.2160	396.9997	(264)
Space and water heating			1039.4627	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Total kg/year			1263.9212	(272)
CO2 emissions per m2			15.7400	(273)
EI value			86.4854	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124	(36)
Total fabric heat loss	(33) + (36) =	56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	95.8146	95.3459	95.3459	94.6856	94.6856	93.8853	94.0768	93.6995	93.8853	94.2740	94.2740	94.9000	(39)
Average = Sum(39)m / 12 =												94.5727	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1929	1.1871	1.1871	1.1789	1.1789	1.1689	1.1713	1.1666	1.1689	1.1737	1.1737	1.1815	(40)
HLP (average)												1.1774	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	11.9814	0.4600	0.0000	0.7700	3.4799	(74)
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	104.8830	184.4708	299.9826	451.2647	539.7261	591.9205	557.1610	488.5972	378.2455	233.6507	133.9392	85.4457	(83)
Total gains	661.2785	736.4654	830.5247	948.5666	1003.0121	1024.7379	972.1767	911.9047	820.6871	709.5445	647.0020	626.6122	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5043	34.6739	34.6739	34.9157	34.9157	35.2133	35.1416	35.2831	35.2133	35.0681	35.0681	34.8368	
alpha	3.3003	3.3116	3.3116	3.3277	3.3277	3.3476	3.3428	3.3522	3.3476	3.3379	3.3379	3.3225	
util living area													
	0.9630	0.9465	0.9037	0.8067	0.6519	0.4393	0.2962	0.3235	0.5955	0.8466	0.9403	0.9677	(86)
MIT	19.4883	19.6831	20.0674	20.5109	20.8227	20.9669	20.9937	20.9916	20.9043	20.5108	19.9424	19.4567	(87)
Th 2	19.9257	19.9304	19.9304	19.9370	19.9370	19.9450	19.9430	19.9468	19.9450	19.9411	19.9411	19.9348	(88)
util rest of house													
	0.9555	0.9360	0.8845	0.7697	0.5891	0.3537	0.1970	0.2195	0.5083	0.8073	0.9264	0.9611	(89)
MIT 2	17.9563	18.2372	18.7796	19.3848	19.7716	19.9250	19.9413	19.9443	19.8738	19.4052	18.6200	17.9172	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3401	18.5994	19.1022	19.6669	20.0349	20.1860	20.2049	20.2067	20.1319	19.6821	18.9512	18.3028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1901	18.4494	18.9522	19.5169	19.8849	20.0360	20.0549	20.0567	19.9819	19.5321	18.8012	18.1528	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9389	0.9168	0.8628	0.7530	0.5858	0.3613	0.2077	0.2305	0.5116	0.7892	0.9067	0.9458	(94)
Useful gains	620.8961	675.1848	716.5931	714.2491	587.5228	370.2632	201.8797	210.2382	419.8433	560.0045	586.6455	592.6537	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.2209	1225.1375	1101.4518	910.5825	651.9010	378.9224	202.7308	211.4504	448.9510	747.7952	1018.2768	1238.7118	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	471.1937	369.5682	286.3349	141.3601	47.8974	0.0000	0.0000	0.0000	0.0000	139.7163	310.7746	480.6672	(98)
Space heating												2247.5123	(98)
Space heating per m2											(98) / (4) =	27.9820	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2483.4390	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	471.1937	369.5682	286.3349	141.3601	47.8974	0.0000	0.0000	0.0000	0.0000	139.7163	310.7746	480.6672	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	520.6560	408.3627	316.3921	156.1990	52.9253	0.0000	0.0000	0.0000	0.0000	154.3826	343.3973	531.1240	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6435	89.5717	89.3676	88.9185	88.1446	87.3000	87.3000	87.3000	87.3000	88.8794	89.4366	89.6740	(217)
Fuel for water heating, kWh/month													
	185.3033	162.6447	169.2820	149.8482	146.1829	129.0595	121.2740	136.7748	137.7020	155.5978	166.8374	179.8956	(219)
Water heating fuel used												1840.4022	(219)
Annual totals kWh/year													
Space heating fuel - main system												2483.4390	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Total delivered energy for all uses												4756.3239	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2483.4390	3.9200	97.3508	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.4022	3.9200	72.1438	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	357.4827	16.9600	60.6291	(250)
Additional standing charges			88.0000	(251)
Total energy cost			330.8436	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2483.4390	0.2160	536.4228	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4022	0.2160	397.5269	(264)
Space and water heating			933.9497	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Total kg/year			1158.4082	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2483.4390	1.2200	3029.7955	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4022	1.2200	2245.2907	(264)
Space and water heating			5275.0862	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	357.4827	3.0700	1097.4719	(268)
Primary energy kWh/year			6602.8081	(272)
Primary energy kWh/m2/year			82.2063	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (15.7%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£257	£220	£38
Space heating	£198	£198	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£330	-£7	£339
Total cost of uses	£331	-£7	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	82 kWh/m²	0 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11901.6490	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	148.1779	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.4124	(36)
Total fabric heat loss	(33) + (36) = 56.5142	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	98.2070	97.9183	97.6354	96.3063	96.0576	94.9000	94.9000	94.6856	95.3459	96.0576	96.5606	97.0866	(39)
Average = Sum(39)m / 12 =												96.3051	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2191	1.2156	1.1990	1.1959	1.1815	1.1815	1.1789	1.1871	1.1959	1.2022	1.2087	(40)
HLP (average)												1.1990	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)
Total heat required for water heating calculated for each month												
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2416	(H8)
Utilisation factor												0.5531	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-844.3736	(H17)
Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899	(63)
								Solar input (sum of months) = Sum(63)m =				-844.3736	(63)
Output from w/h													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
								Total per year (kWh/year) = Sum(64)m =				794.2995	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	10.6334	0.4600	0.0000	0.7700	3.0884	(74)
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	92.2718	180.3637	297.3425	435.1388	535.2371	548.9271	522.1732	447.1160	346.2156	214.0391	115.0111	75.9147	(83)
Total gains	648.6673	732.3584	827.8846	932.4407	998.5231	981.7445	937.1889	870.4234	788.6572	689.9329	628.0739	617.0812	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6637	33.7630	33.8608	34.3281	34.4170	34.8368	34.8368	34.9157	34.6739	34.4170	34.2377	34.0522	
alpha	3.2442	3.2509	3.2574	3.2885	3.2945	3.3225	3.3225	3.3277	3.3116	3.2945	3.2825	3.2701	
util living area													
	0.9696	0.9539	0.9195	0.8441	0.7228	0.5639	0.4282	0.4741	0.6943	0.8852	0.9542	0.9737	(86)
MIT	19.2897	19.5137	19.8908	20.3561	20.7076	20.9081	20.9722	20.9609	20.8116	20.3386	19.7366	19.2510	(87)
Th 2	19.9019	19.9047	19.9076	19.9208	19.9233	19.9348	19.9348	19.9370	19.9304	19.9233	19.9182	19.9130	(88)
util rest of house													
	0.9636	0.9450	0.9037	0.8138	0.6707	0.4863	0.3316	0.3747	0.6210	0.8557	0.9438	0.9685	(89)
MIT 2	17.6544	17.9775	18.5153	19.1666	19.6234	19.8627	19.9204	19.9151	19.7649	19.1618	18.3117	17.6057	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0641	18.3623	18.8599	19.4645	19.8950	20.1246	20.1839	20.1771	20.0271	19.4566	18.6686	18.0178	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9141	18.2123	18.7099	19.3145	19.7450	19.9746	20.0339	20.0271	19.8771	19.3066	18.5186	17.8678	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9483	0.9264	0.8818	0.7940	0.6612	0.4894	0.3409	0.3835	0.6169	0.8349	0.9254	0.9545	(94)
Useful gains	615.1481	678.4662	730.0328	740.3266	660.2461	480.4782	319.4529	333.8425	486.5369	576.0088	581.2508	589.0186	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1336.9953	1303.5211	1192.1150	1002.9857	772.7838	510.0452	325.8764	343.4300	550.8195	836.3333	1102.5904	1326.9647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	537.0543	420.0369	343.7892	189.1145	83.7280	0.0000	0.0000	0.0000	0.0000	193.6815	375.3645	549.0319	(98)
Space heating												2691.8008	(98)
Space heating per m2											(98) / (4) =	33.5135	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2974.3655	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	537.0543	420.0369	343.7892	189.1145	83.7280	0.0000	0.0000	0.0000	0.0000	193.6815	375.3645	549.0319	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	593.4302	464.1291	379.8775	208.9663	92.5171	0.0000	0.0000	0.0000	0.0000	214.0127	414.7674	606.6650	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8130	89.8423	89.8675	89.9247	90.0377	87.3000	87.3000	87.3000	87.3000	89.4908	89.7026	89.8278	(217)
Fuel for water heating, kWh/month	157.6913	116.6765	90.9074	44.4621	15.1460	0.0000	0.0000	24.9065	50.0868	96.1685	133.9657	156.7774	(219)
Water heating fuel used												886.7882	(219)

Annual totals kWh/year		
Space heating fuel - main system	2974.3655	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394	-1727.2394	(233)
Total delivered energy for all uses	2616.3970	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2974.3655	3.4800	103.5079	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.7882	3.4800	30.8602	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	357.4827	13.1900	47.1520	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			90.1847	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3022	(257)
SAP value	95.7837	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2974.3655	0.2160	642.4629	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.7882	0.2160	191.5463	(264)
Space and water heating			834.0092	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			187.9805	(272)
CO2 emissions per m2			2.3400	(273)
EI value			97.9900	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			9.1300	1.2357	11.2823			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	15.7700	76.9300	0.2500	19.2325	52.3000	4023.4390	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.1018			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11901.6490 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.1779 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4124 (36)
Total fabric heat loss	(33) + (36) =	56.5142 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	95.8146	95.3459	95.3459	94.6856	94.6856	93.8853	94.0768	93.6995	93.8853	94.2740	94.2740	94.9000	(39)
Average = Sum(39)m / 12 =												94.5727	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1929	1.1871	1.1871	1.1789	1.1789	1.1689	1.1713	1.1666	1.1689	1.1737	1.1737	1.1815	(40)
HLP (average)												1.1774	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3113	(H8)
Utilisation factor												0.5336	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-860.2505	(H17)
Solar input	-26.4781	-39.7965	-67.0223	-92.6454	-111.5762	-117.4291	-114.6094	-102.3469	-79.8821	-54.3423	-32.1848	-21.9373	(63)
										Solar input (sum of months) = Sum(63)m =		-860.2505	(63)
Output from w/h													
	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
										Total per year (kWh/year) = Sum(64)m =		785.4083	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.6054	44.9472	36.5536	27.6734	20.6862	17.4642	18.8706	24.5288	32.9224	41.8026	48.7898	52.0119	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.3955	551.9947	530.5421	497.3019	463.2860	432.8174	415.0157	423.3074	442.4416	475.8938	513.0628	541.1665	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8200	11.9814	0.4600	0.0000	0.7700	3.4799	(74)
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	104.8830	184.4708	299.9826	451.2647	539.7261	591.9205	557.1610	488.5972	378.2455	233.6507	133.9392	85.4457	(83)
Total gains	661.2785	736.4654	830.5247	948.5666	1003.0121	1024.7379	972.1767	911.9047	820.6871	709.5445	647.0020	626.6122	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5043	34.6739	34.6739	34.9157	34.9157	35.2133	35.1416	35.2831	35.2133	35.0681	35.0681	34.8368	
alpha	3.3003	3.3116	3.3116	3.3277	3.3277	3.3476	3.3428	3.3522	3.3476	3.3379	3.3379	3.3225	
util living area													
	0.9630	0.9465	0.9037	0.8067	0.6519	0.4393	0.2962	0.3235	0.5955	0.8466	0.9403	0.9677	(86)
MIT	19.4883	19.6831	20.0674	20.5109	20.8227	20.9669	20.9937	20.9916	20.9043	20.5108	19.9424	19.4567	(87)
Th 2	19.9257	19.9304	19.9304	19.9370	19.9370	19.9450	19.9430	19.9468	19.9450	19.9411	19.9411	19.9348	(88)
util rest of house													
	0.9555	0.9360	0.8845	0.7697	0.5891	0.3537	0.1970	0.2195	0.5083	0.8073	0.9264	0.9611	(89)
MIT 2	17.9563	18.2372	18.7796	19.3848	19.7716	19.9250	19.9413	19.9443	19.8738	19.4052	18.6200	17.9172	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3401	18.5994	19.1022	19.6669	20.0349	20.1860	20.2049	20.2067	20.1319	19.6821	18.9512	18.3028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1901	18.4494	18.9522	19.5169	19.8849	20.0360	20.0549	20.0567	19.9819	19.5321	18.8012	18.1528	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9389	0.9168	0.8628	0.7530	0.5858	0.3613	0.2077	0.2305	0.5116	0.7892	0.9067	0.9458	(94)
Useful gains	620.8961	675.1848	716.5931	714.2491	587.5228	370.2632	201.8797	210.2382	419.8433	560.0045	586.6455	592.6537	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.2209	1225.1375	1101.4518	910.5825	651.9010	378.9224	202.7308	211.4504	448.9510	747.7952	1018.2768	1238.7118	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	471.1937	369.5682	286.3349	141.3601	47.8974	0.0000	0.0000	0.0000	0.0000	139.7163	310.7746	480.6672	(98)
Space heating												2247.5123	(98)
Space heating per m2											(98) / (4) =	27.9820	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2483.4390	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	471.1937	369.5682	286.3349	141.3601	47.8974	0.0000	0.0000	0.0000	0.0000	139.7163	310.7746	480.6672	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	520.6560	408.3627	316.3921	156.1990	52.9253	0.0000	0.0000	0.0000	0.0000	154.3826	343.3973	531.1240	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7480	89.7672	89.7520	89.7659	89.6291	87.3000	87.3000	87.3000	87.3000	89.2718	89.6015	89.7604	(217)
Fuel for water heating, kWh/month	155.5850	117.9574	93.8819	45.2258	19.2751	0.0000	0.0000	19.5389	46.1990	94.0410	130.6103	155.2827	(219)
Water heating fuel used												877.5972	(219)
Annual totals kWh/year													
Space heating fuel - main system												2483.4390	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												2019.3592	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2483.4390	3.9200	97.3508	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.5972	3.9200	34.4018	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	357.4827	16.9600	60.6291	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-7.7958	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2483.4390	0.2160	536.4228	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.5972	0.2160	189.5610	(264)
Space and water heating			725.9838	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	357.4827	0.5190	185.5335	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			29.6535	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2483.4390	1.2200	3029.7955	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.5972	1.2200	1070.6685	(264)
Space and water heating			4100.4641	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	357.4827	3.0700	1097.4719	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-18.4841	(272)
Primary energy kWh/m2/year			-0.2301	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	148.2 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	56.51	(37)
Summer heat loss coefficient	330.58	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.8200	81.1852	0.4600	0.0000	0.9000	27.5607
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						651.2272

	Jun	Jul	Aug	
Solar gains	692	651	571	(P4)
Internal gains	430	412	420	
Total summer gains	1122	1063	991	(P5)
Summer gain/loss ratio	3.39	3.22	3.00	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 148.2)	0.96	0.96	0.96	
Threshold temperature	20.36	22.08	21.76	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-348	**Issued on Date**	19/10/2022
Assessment Reference	Plot 348	**Prop Type Ref**	2-Opp-SEMI
Property	Plot 348, 2 Bed, K, WC, B		

SAP Rating	84 B	**DER**	16.99	**TER**	18.65
Environmental	87 B	**% DER<TER**	8.90		
CO_2 Emissions (t/year)	1.14	**DFEE**	46.50	**TFEE**	54.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.97		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 3.63 m², No overhang
Windows facing South: 2.47 m², No overhang
Windows facing West: 9.19 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.039 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399	(36)
Total fabric heat loss	(33) + (36) =	58.4681	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.6295	373.5394	360.0184	338.2053	316.0504	294.6984	280.8260	286.8071	298.0097	320.0347	345.3427	364.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	505.7151	614.9882	732.6616	853.6760	930.0844	917.1096	875.8067	808.4848	721.3041	599.3001	505.0269	473.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9844	0.9707	0.9402	0.8715	0.7560	0.6006	0.4615	0.5117	0.7365	0.9172	0.9742	0.9873	(86)
MIT	19.0157	19.2909	19.7222	20.2437	20.6455	20.8821	20.9625	20.9474	20.7611	20.2012	19.5101	18.9711	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9812	0.9647	0.9277	0.8445	0.7055	0.5203	0.3577	0.4057	0.6647	0.8938	0.9679	0.9846	(89)
MIT 2	17.2491	17.6486	18.2683	19.0051	19.5353	19.8213	19.8957	19.8876	19.6963	18.9665	17.9785	17.1909	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.6916	18.0600	18.6325	19.3154	19.8134	20.0870	20.1630	20.1530	19.9630	19.2758	18.3622	17.6368	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5416	17.9100	18.4825	19.1654	19.6634	19.9370	20.0130	20.0030	19.8130	19.1258	18.2122	17.4868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9708	0.9494	0.9068	0.8227	0.6930	0.5221	0.3675	0.4146	0.6574	0.8721	0.9537	0.9757	(94)
Useful gains	490.9349	583.8576	664.3911	702.3471	644.5632	478.7803	321.8245	335.1603	474.1780	522.6556	481.6212	461.4981	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1326.2917	1299.3356	1193.3260	1008.6767	780.5059	516.9093	330.5586	348.1962	555.8770	835.6239	1094.7154	1315.9311	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	621.5054	480.8012	393.5276	220.5573	101.1413	0.0000	0.0000	0.0000	0.0000	232.8484	441.4278	635.6982	(98)
Space heating												3127.5073	(98)
Space heating per m2											(98) / (4) =	38.9381	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3455.8091	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	621.5054	480.8012	393.5276	220.5573	101.1413	0.0000	0.0000	0.0000	0.0000	232.8484	441.4278	635.6982	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	686.7464	531.2721	434.8371	243.7097	111.7584	0.0000	0.0000	0.0000	0.0000	257.2910	487.7655	702.4289	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8057	89.7351	89.5881	89.2677	88.6789	87.3000	87.3000	87.3000	87.3000	89.2806	89.6696	89.8335	(217)
Fuel for water heating, kWh/month													
	184.9686	162.3484	168.8652	149.2620	145.3021	129.0595	121.2740	136.7748	137.7020	154.8986	166.4037	179.5762	(219)
Water heating fuel used												1836.4354	(219)
Annual totals kWh/year													
Space heating fuel - main system												3455.8091	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5718.2906	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3455.8091	0.2160	746.4548	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4354	0.2160	396.6700	(264)
Space and water heating			1143.1248	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/year			1364.2427	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.9900	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		35.4483	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.4483	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	387.8230	385.4672	371.3253	348.8939	326.1155	304.1423	290.2788	296.8805	308.7106	331.3540	357.2775	376.5281	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	500.0642	593.7955	692.8516	793.6555	855.9201	841.1749	803.6437	746.9976	673.9401	572.3114	495.0572	470.3029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9976	0.9942	0.9833	0.9447	0.8463	0.6737	0.5085	0.5643	0.8197	0.9705	0.9950	0.9982	(86)
MIT	19.6866	19.8647	20.1545	20.5211	20.8062	20.9543	20.9906	20.9848	20.8791	20.4879	20.0188	19.6596	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9968	0.9922	0.9773	0.9247	0.7941	0.5803	0.3908	0.4429	0.7413	0.9560	0.9929	0.9976	(89)
MIT 2	18.1612	18.4227	18.8441	19.3702	19.7406	19.9075	19.9335	19.9330	19.8383	19.3362	18.6580	18.1296	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5433	18.7839	19.1724	19.6585	20.0075	20.1697	20.1983	20.1965	20.0990	19.6247	18.9989	18.5129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9893	0.9719	0.9187	0.7986	0.6020	0.4204	0.4734	0.7552	0.9506	0.9903	0.9965	(94)
Useful gains	497.7192	587.4441	673.3627	729.0980	683.5541	506.3781	337.8680	353.6432	508.9453	544.0125	490.2700	468.6384	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1395.7710	1356.5581	1234.6029	1033.8842	796.2859	527.4303	340.7500	358.6984	570.7523	865.0223	1146.4932	1386.5926	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating												3300.1463	(98)
Space heating per m2											(98) / (4) =	41.0875	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3533.3472	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.1506	516.8446	417.5627	219.4461	83.8725	0.0000	0.0000	0.0000	0.0000	238.8313	472.4807	682.9579	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	715.3646	553.3668	447.0692	234.9530	89.7992	0.0000	0.0000	0.0000	0.0000	255.7080	505.8679	731.2184	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8315	87.5811	87.0397	85.7848	83.5252	80.3000	80.3000	80.3000	80.3000	85.8781	87.3264	87.9183	(217)
Fuel for water heating, kWh/month													
	230.4413	202.9497	212.4694	191.2064	190.1295	174.1812	166.8789	186.0308	188.0853	200.2614	210.2295	224.7787	(219)
Water heating fuel used												2377.6422	(219)
Annual totals kWh/year													
Space heating fuel - main system												3533.3472	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												6337.0355	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3533.3472	0.2160	763.2030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2377.6422	0.2160	513.5707	(264)
Space and water heating			1276.7737	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total CO2, kg/m2/year			1497.8916	(272)
Emissions per m2 for space and water heating			15.8961	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2683	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8961 * 1.00) + 2.2683 + 0.4846, rounded to 2 d.p.			18.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3950	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	473.3592	583.4135	702.7091	825.9260	903.7654	892.8026	853.2064	783.6939	695.7320	571.4490	474.6018	441.4329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9871	0.9746	0.9460	0.8800	0.7670	0.6123	0.4720	0.5249	0.7508	0.9259	0.9782	0.9896	(86)
MIT	18.9640	19.2429	19.6814	20.2146	20.6286	20.8751	20.9600	20.9433	20.7460	20.1662	19.4630	18.9199	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9843	0.9692	0.9345	0.8543	0.7173	0.5317	0.3665	0.4172	0.6802	0.9043	0.9728	0.9873	(89)
MIT 2	18.0334	18.3112	18.7433	19.2633	19.6389	19.8469	19.9009	19.8953	19.7537	19.2318	18.5417	17.9976	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.2665	18.5446	18.9783	19.5016	19.8868	20.1045	20.1662	20.1578	20.0023	19.4659	18.7725	18.2286	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2665	18.5446	18.9783	19.5016	19.8868	20.1045	20.1662	20.1578	20.0023	19.4659	18.7725	18.2286	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9607	0.9227	0.8433	0.7165	0.5467	0.3919	0.4424	0.6868	0.8936	0.9652	0.9826	(94)
Useful gains	463.3161	560.4902	648.4026	696.5111	647.5258	488.1072	334.3800	346.7099	477.8524	510.6548	458.0934	433.7725	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1398.9009	1362.7145	1242.7012	1041.7155	802.4003	533.1280	345.4046	363.1543	574.2930	868.9562	1149.9110	1389.4046	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	696.0751	539.0947	442.1582	248.5472	115.2266	0.0000	0.0000	0.0000	0.0000	266.5762	498.1087	710.9903	(98)
Space heating												3516.7770	(98)
Space heating per m2											(98) / (4) =	43.7846	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	910.4273	716.7194	734.4609	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8418	0.8945	0.8696	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	766.4069	641.1320	638.6928	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.6896	1087.5076	1007.8281	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	265.8836	332.1034	274.6366	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												872.6236	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	66.4709	83.0259	68.6592	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												218.1559	(107)
Space cooling per m2												2.7161	(108)
Energy for space heating												43.7846	(99)
Energy for space cooling												2.7161	(108)
Total												46.5007	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			15.2900	1.3258	20.2708			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.1800	13.5504			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.3928			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9281	(36)
Total fabric heat loss (33) + (36) =	56.3209	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	97.9950	97.7070	97.4248	96.0990	95.8510	94.6963	94.6963	94.4825	95.1411	95.8510	96.3528	96.8774	(39)
Average = Sum(39)m / 12 =												96.0978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2201	1.2165	1.2130	1.1965	1.1934	1.1790	1.1790	1.1763	1.1845	1.1934	1.1996	1.2061	(40)
HLP (average)												1.1964	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.8777	17.6552	14.3582	10.8701	8.1255	6.8599	7.4123	9.6348	12.9319	16.4200	19.1645	20.4301	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.2737	341.9647	330.0659	310.4553	289.7313	270.3914	258.2257	262.0162	272.4376	292.1836	314.9176	332.7496	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.6300	0.7000	0.7700	21.7884	(76)
South	2.4700	46.7521	0.6300	0.7000	0.7700	35.2915	(78)
West	9.1900	19.6403	0.6300	0.7000	0.7700	55.1613	(80)

Solar gains	112.2412	208.3283	321.5263	444.7616	529.8046	537.0326	513.3648	450.1172	365.2295	240.9575	137.7797	93.7748	(83)
Total gains	455.5149	550.2930	651.5922	755.2169	819.5359	807.4240	771.5905	712.1334	637.6670	533.1410	452.6973	426.5244	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9190	57.0868	57.2522	58.0420	58.1922	58.9017	58.9017	59.0350	58.6264	58.1922	57.8891	57.5757	
alpha	4.7946	4.8058	4.8168	4.8695	4.8795	4.9268	4.9268	4.9357	4.9084	4.8795	4.8593	4.8384	
util living area													
	0.9984	0.9958	0.9869	0.9534	0.8628	0.6949	0.5278	0.5883	0.8426	0.9775	0.9966	0.9989	(86)
MIT	19.6357	19.8157	20.1103	20.4867	20.7862	20.9477	20.9890	20.9818	20.8615	20.4481	19.9708	19.6093	(87)
Th 2	19.9040	19.9068	19.9096	19.9228	19.9253	19.9368	19.9368	19.9390	19.9324	19.9253	19.9203	19.9151	(88)
util rest of house													
	0.9979	0.9944	0.9821	0.9359	0.8135	0.6011	0.4065	0.4635	0.7683	0.9659	0.9952	0.9985	(89)
MIT 2	18.6634	18.8450	19.1392	19.5142	19.7841	19.9135	19.9342	19.9340	19.8569	19.4858	19.0109	18.6459	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9069	19.0882	19.3824	19.7578	20.0351	20.1726	20.1984	20.1965	20.1086	19.7269	19.2514	18.8872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9929	0.9791	0.9327	0.8192	0.6233	0.4372	0.4951	0.7824	0.9631	0.9939	0.9979	(94)
Useful gains	454.2309	546.3609	637.9664	704.3706	671.3454	503.2474	337.3349	352.5620	498.8992	513.4908	449.9441	425.6452	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1431.4050	1386.2859	1255.0688	1043.4237	798.9274	527.7029	340.7552	358.6991	571.6601	874.8184	1170.8186	1422.8601	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	727.0175	564.4296	459.1242	244.1182	94.9210	0.0000	0.0000	0.0000	0.0000	268.8277	519.0296	741.9278	(98)
Space heating												3619.3957	(98)
Space heating per m2											(98) / (4) =	45.0622	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	890.1454	700.7528	718.0669	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8876	0.9393	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	790.0736	658.2243	658.7034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.8965	992.1124	924.1859	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9925	248.4128	197.5189	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												622.9242	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   44.2481   62.1032   49.3797    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        155.7311 (107)
Space cooling per m2                                                                                                   1.9389 (108)
Energy for space heating                                                                                              45.0622 (99)
Energy for space cooling                                                                                               1.9389 (108)
Total                                                                                                                 47.0011 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                54.1 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)

Space heating 2190.3091 (98)
RHI space heating demand 2190 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833 (83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9647	0.9440	0.9031	0.8208	0.6966	0.5398	0.4070	0.4485	0.6604	0.8636	0.9459	0.9697	(86)
MIT	19.2919	19.5467	19.9356	20.3914	20.7256	20.9139	20.9741	20.9642	20.8294	20.3744	19.7539	19.2461	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6430	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6460	18.0117	18.5629	19.1957	19.6257	19.8486	19.9021	19.8978	19.7639	19.1928	18.3234	17.5873	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.0583	18.3962	18.9067	19.4952	19.9012	20.1154	20.1706	20.1650	20.0308	19.4888	18.6817	18.0028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9083	18.2462	18.7567	19.3452	19.7512	19.9654	20.0206	20.0150	19.8808	19.3388	18.5317	17.8528	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9130	0.8618	0.7687	0.6348	0.4665	0.3222	0.3607	0.5833	0.8097	0.9138	0.9484	(94)
Useful gains	645.0927	723.6388	777.8252	778.0911	683.6470	492.0743	325.3593	340.6578	504.5980	610.8538	613.9852	615.3987	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1363.0212	1332.9153	1220.6415	1026.3498	789.1137	519.6630	331.3030	349.3476	562.4756	856.4989	1126.1903	1352.1836	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating												2629.9570	(98)
Space heating per m2											(98) / (4) =	32.7435	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2906.0298	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	590.2086	452.4131	364.0390	197.5097	86.7041	0.0000	0.0000	0.0000	0.0000	201.9446	407.5002	605.7104	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7199	89.6377	89.4680	89.1051	88.4842	87.3000	87.3000	87.3000	87.3000	89.0933	89.5544	89.7520	(217)
Fuel for water heating, kWh/month													
	185.1457	162.5248	169.0920	149.5344	145.6219	129.0595	121.2740	136.7748	137.7020	155.2243	166.6178	179.7394	(219)
Water heating fuel used												1838.3106	(219)
Annual totals kWh/year													
Space heating fuel - main system												2906.0298	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												5170.3865	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.0298	3.4800	101.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.3106	3.4800	63.9732	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Total energy cost			341.2985	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1438	(257)
SAP value		84.0435	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2906.0298	0.2160	627.7024	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.3106	0.2160	397.0751	(264)
Space and water heating			1024.7775	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1245.8955	(272)
CO2 emissions per m2			15.5100	(273)
EI value			86.6781	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8867 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8867 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840	(83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating												2190.3091	(98)
Space heating per m2											(98) / (4) =	27.2698	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.2310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	515.8749	397.6604	302.8182	147.0689	49.5429	0.0000	0.0000	0.0000	0.0000	143.9357	334.6058	528.7243	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6377	89.5541	89.3353	88.8703	88.1042	87.3000	87.3000	87.3000	87.3000	88.8234	89.4181	89.6713	(217)
Fuel for water heating, kWh/month													
	185.3153	162.6766	169.3432	149.9294	146.2500	129.0595	121.2740	136.7748	137.7020	155.6959	166.8719	179.9012	(219)
Water heating fuel used												1840.7938	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.2310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Total delivered energy for all uses												4687.0709	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.2310	3.9200	94.8731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.7938	3.9200	72.1591	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Total energy cost			327.2896	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2420.2310	0.2160	522.7699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7938	0.2160	397.6115	(264)
Space and water heating			920.3814	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Total kg/year			1141.4993	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2420.2310	1.2200	2952.6818	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.7938	1.2200	2245.7684	(264)
Space and water heating			5198.4502	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Primary energy kWh/year			6506.4118	(272)
Primary energy kWh/m2/year			81.0061	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 87

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-182 kg (15.9%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (98.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 89
Solar photovoltaic panels	£309	11.79 kg/m²	A 96	A 98
Total Savings	£339	14.05 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£72	£81	-£8
Mains gas	£255	£217	£38
Space heating	£196	£196	£0
Water heating	£72	£43	£29
Lighting	£60	£60	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£327	-£11	£339
Total cost of uses	£328	-£10	£338
Delivered energy	58 kWh/m²	24 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	81 kWh/m²	-1 kWh/m²	82 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3950	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4658	0.4567	0.4476	0.4019	0.3928	0.3471	0.3471	0.3380	0.3654	0.3928	0.4110	0.4293	(22b)
Effective ac	0.6085	0.6043	0.6002	0.5808	0.5771	0.5602	0.5602	0.5571	0.5667	0.5771	0.5845	0.5922	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6928	41.4042	41.1212	39.7921	39.5434	38.3858	38.3858	38.1715	38.8317	39.5434	40.0465	40.5724	(38)
Heat transfer coeff	100.1610	99.8723	99.5893	98.2602	98.0116	96.8540	96.8540	96.6396	97.2999	98.0116	98.5146	99.0405	(39)
Average = Sum(39)m / 12 =												98.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2434	1.2399	1.2234	1.2203	1.2059	1.2059	1.2032	1.2114	1.2203	1.2265	1.2331	(40)
HLP (average)												1.2233	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2416	(H8)
Utilisation factor												0.5531	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-844.3736	(H17)
Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899	(63)
											Solar input (sum of months) = Sum(63)m =	-844.3736	(63)
Output from w/h													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
											Total per year (kWh/year) = Sum(64)m =	794.2995	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	19.6403	0.4600	0.0000	0.7700	25.2524	(76)
South	2.4700	46.7521	0.4600	0.0000	0.7700	40.9022	(78)
West	4.6800	19.6403	0.4600	0.0000	0.7700	32.5568	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	130.0855	241.4488	372.6432	515.4707	614.0341	622.4112	594.9807	521.6777	423.2944	279.2654	159.6842	108.6833	(83)
Total gains	685.5699	792.6342	902.5272	1012.2743	1076.9476	1054.9142	1009.6566	944.5435	865.1432	754.4065	671.8685	648.9133	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7677	32.8624	32.9558	33.4015	33.4863	33.8865	33.8865	33.9617	33.7312	33.4863	33.3153	33.1384	
alpha	3.1845	3.1908	3.1971	3.2268	3.2324	3.2591	3.2591	3.2641	3.2487	3.2324	3.2210	3.2092	
util living area													
	0.9647	0.9440	0.9031	0.8208	0.6966	0.5398	0.4070	0.4485	0.6604	0.8636	0.9459	0.9697	(86)
MIT	19.2919	19.5467	19.9356	20.3914	20.7256	20.9139	20.9741	20.9642	20.8294	20.3744	19.7539	19.2461	(87)
Th 2	19.8826	19.8854	19.8882	19.9014	19.9038	19.9153	19.9153	19.9175	19.9109	19.9038	19.8988	19.8936	(88)
util rest of house													
	0.9578	0.9335	0.8848	0.7878	0.6430	0.4627	0.3128	0.3516	0.5855	0.8304	0.9339	0.9638	(89)
MIT 2	17.6460	18.0117	18.5629	19.1957	19.6257	19.8486	19.9021	19.8978	19.7639	19.1928	18.3234	17.5873	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.0583	18.3962	18.9067	19.4952	19.9012	20.1154	20.1706	20.1650	20.0308	19.4888	18.6817	18.0028	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9083	18.2462	18.7567	19.3452	19.7512	19.9654	20.0206	20.0150	19.8808	19.3388	18.5317	17.8528	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9410	0.9130	0.8618	0.7687	0.6348	0.4665	0.3222	0.3607	0.5833	0.8097	0.9138	0.9484	(94)
Useful gains	645.0927	723.6388	777.8252	778.0911	683.6470	492.0743	325.3593	340.6578	504.5980	610.8538	613.9852	615.3987	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1363.0212	1332.9153	1220.6415	1026.3498	789.1137	519.6630	331.3030	349.3476	562.4756	856.4989	1126.1903	1352.1836	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating												2629.9570	(98)
Space heating per m2											(98) / (4) =	32.7435	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2906.0298	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	534.1388	409.4338	329.4553	178.7462	78.4672	0.0000	0.0000	0.0000	0.0000	182.7599	368.7877	548.1679	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	590.2086	452.4131	364.0390	197.5097	86.7041	0.0000	0.0000	0.0000	0.0000	201.9446	407.5002	605.7104	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8101	89.8288	89.8456	89.8977	90.0115	87.3000	87.3000	87.3000	87.3000	89.4503	89.6920	89.8270	(217)
Fuel for water heating, kWh/month	157.6965	116.6940	90.9295	44.4755	15.1504	0.0000	0.0000	24.9065	50.0868	96.2121	133.9815	156.7789	(219)
Water heating fuel used												886.9117	(219)

Annual totals kWh/year		
Space heating fuel - main system	2906.0298	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394	-1727.2394	(233)
Total delivered energy for all uses	2541.7483	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.0298	3.4800	101.1298	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	886.9117	3.4800	30.8645	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	351.0461	13.1900	46.3030	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			86.9620	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.2914	(257)
SAP value	95.9343	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2906.0298	0.2160	627.7024	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	886.9117	0.2160	191.5729	(264)
Space and water heating			819.2754	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			169.9061	(272)
CO2 emissions per m2			2.1200	(273)
EI value			98.1833	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3950	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3654	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3836	0.3654	0.3654	0.3380	0.3380	0.3014	0.3106	0.2923	0.3014	0.3197	0.3197	0.3471	(22b)
Effective ac	0.5736	0.5667	0.5667	0.5571	0.5571	0.5454	0.5482	0.5427	0.5454	0.5511	0.5511	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	17.4200	75.2800	0.2500	18.8200	52.3000	3937.1440	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.7283			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11815.3540 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.1035 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7399 (36)
Total fabric heat loss	(33) + (36) =	58.4681 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.3005	38.8317	38.8317	38.1715	38.1715	37.3711	37.5626	37.1854	37.3711	37.7599	37.7599	38.3858	(38)
Heat transfer coeff	97.7686	97.2999	97.2999	96.6396	96.6396	95.8393	96.0308	95.6535	95.8393	96.2280	96.2280	96.8540	(39)
Average = Sum(39)m / 12 =												96.5267	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2114	1.2114	1.2032	1.2032	1.1932	1.1956	1.1909	1.1932	1.1981	1.1981	1.2059	(40)
HLP (average)												1.2018	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)
Total heat required for water heating calculated for each month												
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1140.0998 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1915.3676 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3113 (H8)
Utilisation factor	0.5336 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-860.2505 (H17)

Solar input	-26.4781	-39.7965	-67.0223	-92.6454	-111.5762	-117.4291	-114.6094	-102.3469	-79.8821	-54.3423	-32.1848	-21.9373 (63)
								Solar input (sum of months) = Sum(63)m =				-860.2505 (63)
Output from w/h												
	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824 (64)
								Total per year (kWh/year) = Sum(64)m =				785.4083 (64)
Heat gains from water heating, kWh/month												
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	49.6942	44.1380	35.8954	27.1751	20.3137	17.1497	18.5309	24.0871	32.3297	41.0499	47.9113	51.0754	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	555.4843	551.1854	529.8840	496.8036	462.9135	432.5030	414.6759	422.8658	441.8488	475.1411	512.1843	540.2300	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.6300	22.3313	0.4600	0.0000	0.7700	28.7124	(76)
South	2.4700	50.9848	0.4600	0.0000	0.7700	44.6053	(78)
West	4.6800	22.3313	0.4600	0.0000	0.7700	37.0176	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	146.0083	243.9930	372.1037	530.5034	615.8182	668.1673	631.7474	566.2792	458.1822	301.3680	183.6509	120.7840 (83)
Total gains	701.4926	795.1784	901.9876	1027.3070	1078.7317	1100.6703	1046.4233	989.1450	900.0310	776.5092	695.8352	661.0140 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5695	33.7312	33.7312	33.9617	33.9617	34.2453	34.1770	34.3118	34.2453	34.1069	34.1069	33.8865	
alpha	3.2380	3.2487	3.2487	3.2641	3.2641	3.2830	3.2785	3.2875	3.2830	3.2738	3.2738	3.2591	
util living area													
	0.9568	0.9357	0.8860	0.7818	0.6264	0.4189	0.2812	0.3049	0.5620	0.8208	0.9292	0.9627	(86)
MIT	19.4963	19.7139	20.1063	20.5393	20.8336	20.9689	20.9941	20.9923	20.9143	20.5428	19.9659	19.4571	(87)
Th 2	19.9062	19.9109	19.9109	19.9175	19.9175	19.9254	19.9235	19.9273	19.9254	19.9216	19.9216	19.9153	(88)
util rest of house													
	0.9482	0.9234	0.8642	0.7423	0.5629	0.3351	0.1851	0.2048	0.4755	0.7777	0.9132	0.9552	(89)
MIT 2	17.9555	18.2674	18.8176	19.4031	19.7641	19.9069	19.9219	19.9250	19.8629	19.4281	18.6391	17.9059	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.3414	18.6297	19.1404	19.6877	20.0320	20.1729	20.1905	20.1924	20.1263	19.7073	18.9714	18.2945	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1914	18.4797	18.9904	19.5377	19.8820	20.0229	20.0405	20.0424	19.9763	19.5573	18.8214	18.1445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9025	0.8419	0.7267	0.5607	0.3429	0.1957	0.2157	0.4799	0.7606	0.8921	0.9384	(94)
Useful gains	652.4225	717.6546	759.4004	746.5257	604.8098	377.4647	204.7568	213.3862	431.8852	590.6342	620.7427	620.2685	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1279.9316	1253.1942	1127.7478	931.3832	665.0737	385.5566	205.5533	214.4916	457.7542	765.7173	1041.3236	1263.4075	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating												2190.3091	(98)
Space heating per m2											(98) / (4) =	27.2698	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.2310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	466.8668	359.8826	274.0504	133.0974	44.8363	0.0000	0.0000	0.0000	0.0000	130.2618	302.8182	478.4955	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	515.8749	397.6604	302.8182	147.0689	49.5429	0.0000	0.0000	0.0000	0.0000	143.9357	334.6058	528.7243	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.6344	105.8871	84.2609	40.5974	17.2761	0.0000	0.0000	17.0575	40.3317	83.9521	117.0288	139.3824	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7427	89.7521	89.7266	89.7312	89.5866	87.3000	87.3000	87.3000	87.3000	89.2183	89.5847	89.7578	(217)
Fuel for water heating, kWh/month	155.5942	117.9773	93.9085	45.2433	19.2843	0.0000	0.0000	19.5389	46.1990	94.0973	130.6349	155.2872	(219)
Water heating fuel used												877.7648	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.2310	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												351.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												1949.8823	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.2310	3.9200	94.8731	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.7648	3.9200	34.4084	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	351.0461	16.9600	59.5374	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-11.3586	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2420.2310	0.2160	522.7699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7648	0.2160	189.5972	(264)
Space and water heating			712.3671	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	351.0461	0.5190	182.1929	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			12.6962	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2420.2310	1.2200	2952.6818	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.7648	1.2200	1070.8731	(264)
Space and water heating			4023.5549	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	351.0461	3.0700	1077.7116	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-115.1536	(272)
Primary energy kWh/m2/year			-1.4337	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	147.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07	(P1)
Transmission heat loss coefficient	58.47	(37)
Summer heat loss coefficient	332.54	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.6300	117.5071	0.4600	0.0000	0.9000	176.5920
South	2.4700	112.2060	0.4600	0.0000	0.9000	114.7396
West	4.6800	117.5071	0.4600	0.0000	0.9000	227.6723
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						738.4060

	Jun	Jul	Aug	
Solar gains	781	738	662	(P4)
Internal gains	430	412	420	
Total summer gains	1210	1150	1082	(P5)
Summer gain/loss ratio	3.64	3.46	3.25	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.1)	0.97	0.97	0.97	
Threshold temperature	20.61	22.33	22.02	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-349	**Issued on Date**	19/10/2022
Assessment Reference	Plot 349	**Prop Type Ref**	Badlesmere-As-SEMI
Property	Plot 349, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.46	**TER**	18.83
Environmental	86 B	**% DER<TER**	7.28		
CO_2 Emissions (t/year)	1.16	**DFEE**	47.07	**TFEE**	54.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.43		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.83 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.46 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.1 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 0.72 m², No overhang
Windows facing East: 5.06 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	464.4736	548.4272	649.1701	761.8673	837.3320	829.3170	789.4436	722.3202	635.1359	528.0531	456.5376	437.2541	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9884	0.9793	0.9569	0.8998	0.7940	0.6400	0.4982	0.5542	0.7836	0.9396	0.9812	0.9904	(86)
MIT	18.9946	19.2325	19.6455	20.1796	20.6064	20.8679	20.9574	20.9391	20.7251	20.1425	19.4790	18.9648	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9858	0.9748	0.9472	0.8769	0.7465	0.5590	0.3892	0.4437	0.7161	0.9211	0.9764	0.9883	(89)
MIT 2	17.2160	17.5634	18.1609	18.9249	19.4969	19.8196	19.9038	19.8939	19.6678	18.8914	17.9347	17.1810	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.5834	17.9081	18.4675	19.1841	19.7261	20.0362	20.1214	20.1098	19.8862	19.1498	18.2537	17.5495	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4334	17.7581	18.3175	19.0341	19.5761	19.8862	19.9714	19.9598	19.7362	18.9998	18.1037	17.3995	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9621	0.9283	0.8539	0.7296	0.5557	0.3940	0.4471	0.7026	0.8999	0.9643	0.9808	(94)
Useful gains	453.8395	527.6261	602.5923	650.5524	610.9538	460.8151	311.0728	322.9808	446.2153	475.1715	440.2531	428.8628	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1303.6182	1271.6260	1164.5084	981.6781	760.4865	502.7159	320.6259	337.5799	539.1708	811.0570	1069.4411	1291.5757	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	632.2354	499.9679	418.0656	238.4105	111.2523	0.0000	0.0000	0.0000	0.0000	249.8988	453.0153	641.8584	(98)
Space heating												3244.7042	(98)
Space heating per m2											(98) / (4) =	40.6706	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3585.3085	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	632.2354	499.9679	418.0656	238.4105	111.2523	0.0000	0.0000	0.0000	0.0000	249.8988	453.0153	641.8584	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	698.6026	552.4507	461.9509	263.4370	122.9307	0.0000	0.0000	0.0000	0.0000	276.1313	500.5694	709.2358	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8181	89.7609	89.6308	89.3307	88.7592	87.3000	87.3000	87.3000	87.3000	89.3380	89.6891	89.8416	(217)
Fuel for water heating, kWh/month													
	183.8872	161.3633	167.7836	148.2345	144.2461	128.1956	120.4190	135.8687	136.8056	153.8409	165.3861	178.5214	(219)
Water heating fuel used												1824.5518	(219)
Annual totals kWh/year													
Space heating fuel - main system												3585.3085	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Total delivered energy for all uses	5841.7730	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3585.3085	0.2160	774.4266	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.5518	0.2160	394.1032	(264)
Space and water heating			1168.5298	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1392.6925	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.4600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.4600	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.9563	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.9563	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	464.4856	536.3195	620.7647	714.3935	775.8493	765.3921	729.1025	672.6332	599.5751	510.8194	453.1960	439.4627	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9983	0.9961	0.9886	0.9590	0.8731	0.7063	0.5388	0.6005	0.8561	0.9797	0.9965	0.9987	(86)
MIT	19.6935	19.8471	20.1210	20.4862	20.7849	20.9479	20.9891	20.9819	20.8584	20.4573	20.0123	19.6720	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9977	0.9948	0.9845	0.9433	0.8264	0.6143	0.4184	0.4769	0.7857	0.9692	0.9950	0.9982	(89)
MIT 2	18.1901	18.4163	18.8162	19.3456	19.7417	19.9295	19.9600	19.9587	19.8442	19.3151	18.6679	18.1665	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9925	0.9798	0.9363	0.8266	0.6310	0.4434	0.5024	0.7932	0.9637	0.9929	0.9973	(94)
Useful gains	462.8205	532.2798	608.2253	668.9029	641.3404	482.9731	323.2806	337.9245	475.5798	492.2513	449.9570	438.2566	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1344.3128	1303.5374	1184.2759	990.9332	763.9970	506.1960	326.4405	343.6765	546.6508	828.1996	1101.9511	1335.6629	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating												3312.8667	(98)
Space heating per m2											(98) / (4) =	41.5250	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3546.9665	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	702.1737	554.9091	458.8669	248.2460	97.7050	0.0000	0.0000	0.0000	0.0000	267.6077	502.6078	714.8504	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7995	87.5920	87.1036	85.9289	83.7191	80.3000	80.3000	80.3000	80.3000	85.9979	87.3182	87.8793	(217)
Fuel for water heating, kWh/month													
	230.0739	202.3931	211.7577	190.3861	189.1926	173.7253	166.4421	185.5439	187.5930	199.4590	209.6990	224.4415	(219)
Water heating fuel used												2370.7072	(219)
Annual totals kWh/year													
Space heating fuel - main system												3546.9665	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6349.5864	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3546.9665	0.2160	766.1448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.7072	0.2160	512.0728	(264)
Space and water heating			1278.2175	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1502.3802	(272)
Emissions per m2 for space and water heating			16.0218	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0218 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	432.3673	517.0988	619.4567	734.3470	811.2364	805.2253	767.0523	697.7471	609.7854	500.4330	426.3545	405.9203	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9906	0.9824	0.9613	0.9064	0.8020	0.6491	0.5061	0.5654	0.7956	0.9466	0.9845	0.9923	(86)
MIT	18.9844	19.2231	19.6379	20.1713	20.6022	20.8653	20.9566	20.9369	20.7166	20.1247	19.4591	18.9493	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9885	0.9785	0.9526	0.8847	0.7558	0.5686	0.3970	0.4547	0.7301	0.9299	0.9805	0.9906	(89)
MIT 2	18.0665	18.3054	18.7164	19.2414	19.6376	19.8623	19.9213	19.9142	19.7528	19.2095	18.5515	18.0397	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2561	18.4949	18.9068	19.4335	19.8369	20.0694	20.1352	20.1254	19.9519	19.3985	18.7390	18.2276	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2561	18.4949	18.9068	19.4335	19.8369	20.0694	20.1352	20.1254	19.9519	19.3985	18.7390	18.2276	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9718	0.9422	0.8728	0.7515	0.5794	0.4183	0.4754	0.7315	0.9193	0.9743	0.9869	(94)
Useful gains	425.4934	502.4941	583.6729	640.9683	609.6506	466.5467	320.8603	331.7278	446.0400	460.0696	415.4177	400.6090	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1358.3612	1319.2880	1200.4794	1005.2509	774.5094	514.2908	332.4100	349.5030	552.8575	837.4920	1113.7017	1349.6264	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.0537	548.8855	458.9041	262.2835	122.6549	0.0000	0.0000	0.0000	0.0000	280.8023	502.7645	706.0690	(98)
Space heating												3576.4174	(98)
Space heating per m2											(98) / (4) =	44.8285	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8272	0.8839	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	731.1867	615.0314	609.0983	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1033.1059	986.6144	907.2322	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	217.3819	276.4577	221.8116	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												715.6512	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	54.3455	69.1144	55.4529	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												178.9128	(107)
Space cooling per m2												2.2426	(108)
Energy for space heating												44.8285	(99)
Energy for space cooling												2.2426	(108)
Total												47.0711	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	420.0002	492.9230	579.6054	676.0477	739.5525	731.7217	697.1254	637.8524	563.3892	471.7437	410.9391	395.7460	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9989	0.9973	0.9915	0.9666	0.8894	0.7293	0.5609	0.6280	0.8788	0.9853	0.9977	0.9992	(86)
MIT	19.6419	19.7972	20.0753	20.4491	20.7617	20.9398	20.9870	20.9779	20.8371	20.4154	19.9635	19.6210	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9985	0.9964	0.9883	0.9533	0.8461	0.6376	0.4369	0.5012	0.8142	0.9774	0.9967	0.9989	(89)
MIT 2	18.6908	18.8481	19.1268	19.5028	19.7904	19.9363	19.9607	19.9598	19.8661	19.4773	19.0252	18.6789	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9953	0.9858	0.9493	0.8480	0.6548	0.4628	0.5276	0.8221	0.9745	0.9958	0.9985	(94)
Useful gains	419.1443	490.5901	571.3602	641.7939	627.1262	479.1676	322.6256	336.5415	463.1510	459.7196	409.2036	395.1474	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1380.9137	1334.8978	1206.5707	1001.7884	767.1336	506.5306	326.4500	343.6823	547.8447	839.3066	1127.3915	1372.7109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	715.5564	567.3748	472.5966	259.1960	104.1655	0.0000	0.0000	0.0000	0.0000	282.4127	517.0953	727.3073	(98)
Space heating												3645.7045	(98)
Space heating per m2											(98) / (4) =	45.6970	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8725	0.9298	0.9028	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	749.3878	628.6644	625.4848	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	947.1926	904.8817	837.2253	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	142.4195	205.5057	157.5349	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												505.4600	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   35.6049   51.3764   39.3837    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        126.3650 (107)
Space cooling per m2                                                                                                   1.5839 (108)
Energy for space heating                                                                                              45.6970 (99)
Energy for space cooling                                                                                               1.5839 (108)
Total                                                                                                                 47.2809 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                54.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	11.9814	0.4600	0.0000	0.7700	3.0556	(74)
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	102.4811	180.2549	293.0837	440.7208	526.9157	577.7640	543.8802	477.1050	369.4988	228.3047	130.8756	83.4858	(83)
Total gains	656.4736	729.8448	821.2932	935.8174	988.1386	1008.6522	957.0528	898.5589	810.0221	702.1524	641.7401	622.3278	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9646	0.9489	0.9077	0.8132	0.6601	0.4456	0.3008	0.3278	0.6020	0.8513	0.9426	0.9691	(86)
MIT	19.4841	19.6784	20.0596	20.5049	20.8194	20.9666	20.9937	20.9916	20.9037	20.5089	19.9437	19.4583	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9573	0.9386	0.8888	0.7763	0.5966	0.3585	0.1995	0.2220	0.5137	0.8122	0.9289	0.9627	(89)
MIT 2	17.9412	18.2224	18.7609	19.3707	19.7611	19.9192	19.9351	19.9391	19.8680	19.3970	18.6157	17.9120	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2599	18.5232	19.0292	19.6050	19.9797	20.1356	20.1538	20.1565	20.0819	19.6267	18.8900	18.2314	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1099	18.3732	18.8792	19.4550	19.8297	19.9856	20.0038	20.0065	19.9319	19.4767	18.7400	18.0814	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9404	0.9189	0.8661	0.7575	0.5902	0.3624	0.2060	0.2286	0.5130	0.7920	0.9085	0.9471	(94)
Useful gains	617.3522	670.6360	711.3103	708.9143	583.2015	365.5729	197.1146	205.4082	415.5588	556.1168	583.0523	589.3977	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1252.2149	1221.9016	1098.1108	906.1066	647.6658	373.9457	197.8911	206.5124	443.9681	742.8744	1012.9249	1234.5406	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)
Space heating												2248.9500	(98)
RHI space heating demand												2249	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	644.1484	725.8317	818.7261	920.0994	983.7992	966.7307	922.9410	858.0878	778.7521	682.9930	623.2425	613.0125	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9710	0.9562	0.9234	0.8505	0.7317	0.5723	0.4352	0.4810	0.7019	0.8897	0.9563	0.9749	(86)
MIT	19.2731	19.4954	19.8717	20.3431	20.6993	20.9060	20.9715	20.9602	20.8079	20.3306	19.7283	19.2414	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9652	0.9475	0.9080	0.8206	0.6794	0.4934	0.3364	0.3797	0.6279	0.8605	0.9460	0.9698	(89)
MIT 2	17.6175	17.9389	18.4764	19.1396	19.6039	19.8529	19.9118	19.9071	19.7526	19.1420	18.2896	17.5807	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9595	18.2605	18.7647	19.3882	19.8302	20.0705	20.1307	20.1246	19.9706	19.3875	18.5868	17.9238	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8095	18.1105	18.6147	19.2382	19.6802	19.9205	19.9807	19.9746	19.8206	19.2375	18.4368	17.7738	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9285	0.8851	0.7989	0.6670	0.4929	0.3416	0.3842	0.6203	0.8380	0.9272	0.9557	(94)
Useful gains	611.7048	673.9055	724.6924	735.0350	656.1879	476.5222	315.2792	329.6841	483.0492	572.3145	577.8465	585.8300	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1340.9446	1306.4685	1193.7856	1001.4560	770.5354	505.9777	321.5098	338.9823	547.2417	834.0059	1101.8139	1328.1995	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating												2717.8176	(98)
Space heating per m2											(98) / (4) =	34.0664	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3003.1134	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	599.5076	469.7043	385.6413	211.9592	94.0051	0.0000	0.0000	0.0000	0.0000	215.1364	416.8580	610.3015	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7324	89.6647	89.5119	89.1652	88.5500	87.3000	87.3000	87.3000	87.3000	89.1478	89.5734	89.7596	(217)
Fuel for water heating, kWh/month													
	184.0627	161.5365	168.0065	148.5097	144.5869	128.1956	120.4190	135.8687	136.8056	154.1692	165.5997	178.6845	(219)
Water heating fuel used												1826.4444	(219)
Annual totals kWh/year													
Space heating fuel - main system												3003.1134	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5261.4705	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3003.1134	3.4800	104.5083	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.4444	3.4800	63.5603	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			345.0379	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1614	(257)
SAP value		83.7989	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3003.1134	0.2160	648.6725	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.4444	0.2160	394.5120	(264)
Space and water heating			1043.1845	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1267.3471	(272)
CO2 emissions per m2			15.8900	(273)
EI value			86.3901	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	11.9814	0.4600	0.0000	0.7700	3.0556	(74)
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	102.4811	180.2549	293.0837	440.7208	526.9157	577.7640	543.8802	477.1050	369.4988	228.3047	130.8756	83.4858	(83)
Total gains	656.4736	729.8448	821.2932	935.8174	988.1386	1008.6522	957.0528	898.5589	810.0221	702.1524	641.7401	622.3278	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area	0.9646	0.9489	0.9077	0.8132	0.6601	0.4456	0.3008	0.3278	0.6020	0.8513	0.9426	0.9691	(86)
MIT	19.4841	19.6784	20.0596	20.5049	20.8194	20.9666	20.9937	20.9916	20.9037	20.5089	19.9437	19.4583	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house	0.9573	0.9386	0.8888	0.7763	0.5966	0.3585	0.1995	0.2220	0.5137	0.8122	0.9289	0.9627	(89)
MIT 2	17.9412	18.2224	18.7609	19.3707	19.7611	19.9192	19.9351	19.9391	19.8680	19.3970	18.6157	17.9120	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2599	18.5232	19.0292	19.6050	19.9797	20.1356	20.1538	20.1565	20.0819	19.6267	18.8900	18.2314	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1099	18.3732	18.8792	19.4550	19.8297	19.9856	20.0038	20.0065	19.9319	19.4767	18.7400	18.0814	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9404	0.9189	0.8661	0.7575	0.5902	0.3624	0.2060	0.2286	0.5130	0.7920	0.9085	0.9471	(94)
Useful gains	617.3522	670.6360	711.3103	708.9143	583.2015	365.5729	197.1146	205.4082	415.5588	556.1168	583.0523	589.3977	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1252.2149	1221.9016	1098.1108	906.1066	647.6658	373.9457	197.8911	206.5124	443.9681	742.8744	1012.9249	1234.5406	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)

Space heating 2248.9500 (98)
Space heating per m2 (98) / (4) = 28.1894 (99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2485.0276	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	521.9202	409.3376	317.9885	156.8823	52.9960	0.0000	0.0000	0.0000	0.0000	153.5333	341.9981	530.3716	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6486	89.5771	89.3756	88.9270	88.1494	87.3000	87.3000	87.3000	87.3000	88.8799	89.4379	89.6767	(217)
Fuel for water heating, kWh/month													
	184.2347	161.6946	168.2628	148.9076	145.2439	128.1956	120.4190	135.8687	136.8056	154.6338	165.8506	178.8496	(219)
Water heating fuel used												1828.9663	(219)
Annual totals kWh/year													
Space heating fuel - main system												2485.0276	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4745.9066	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2485.0276	3.9200	97.4131	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.9663	3.9200	71.6955	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			330.3609	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2485.0276	0.2160	536.7660	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9663	0.2160	395.0567	(264)
Space and water heating			931.8227	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1155.9854	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2485.0276	1.2200	3031.7337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9663	1.2200	2231.3389	(264)
Space and water heating			5263.0726	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6589.0444	(272)
Primary energy kWh/m2/year			82.5902	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.7%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£257	£219	£38
Space heating	£198	£198	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£330	-£8	£339
Total cost of uses	£331	-£7	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	83 kWh/m²	0 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input -24.4568 -40.8113 -69.5064 -93.1523 -115.0818 -113.1437 -111.6485 -97.5478 -76.3995 -52.1719 -29.0093 -20.4662 (63)
Solar input (sum of months) = Sum(63)m = -843.3953 (63)
Output from w/h

	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)

Total per year (kWh/year) = Sum(64)m = 786.4412 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	644.1484	725.8317	818.7261	920.0994	983.7992	966.7307	922.9410	858.0878	778.7521	682.9930	623.2425	613.0125	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9710	0.9562	0.9234	0.8505	0.7317	0.5723	0.4352	0.4810	0.7019	0.8897	0.9563	0.9749	(86)
MIT	19.2731	19.4954	19.8717	20.3431	20.6993	20.9060	20.9715	20.9602	20.8079	20.3306	19.7283	19.2414	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9652	0.9475	0.9080	0.8206	0.6794	0.4934	0.3364	0.3797	0.6279	0.8605	0.9460	0.9698	(89)
MIT 2	17.6175	17.9389	18.4764	19.1396	19.6039	19.8529	19.9118	19.9071	19.7526	19.1420	18.2896	17.5807	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9595	18.2605	18.7647	19.3882	19.8302	20.0705	20.1307	20.1246	19.9706	19.3875	18.5868	17.9238	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8095	18.1105	18.6147	19.2382	19.6802	19.9205	19.9807	19.9746	19.8206	19.2375	18.4368	17.7738	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9285	0.8851	0.7989	0.6670	0.4929	0.3416	0.3842	0.6203	0.8380	0.9272	0.9557	(94)
Useful gains	611.7048	673.9055	724.6924	735.0350	656.1879	476.5222	315.2792	329.6841	483.0492	572.3145	577.8465	585.8300	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1340.9446	1306.4685	1193.7856	1001.4560	770.5354	505.9777	321.5098	338.9823	547.2417	834.0059	1101.8139	1328.1995	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating												2717.8176	(98)
Space heating per m2											(98) / (4) =	34.0664	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3003.1134	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	599.5076	469.7043	385.6413	211.9592	94.0051	0.0000	0.0000	0.0000	0.0000	215.1364	416.8580	610.3015	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8220	89.8524	89.8802	89.9398	90.0639	87.3000	87.3000	87.3000	87.3000	89.5008	89.7098	89.8344	(217)
Fuel for water heating, kWh/month													
	156.6511	115.7786	89.9859	43.6589	14.3785	0.0000	0.0000	24.1300	49.2919	95.2690	133.0110	155.7536	(219)
Water heating fuel used												877.9085	(219)
Annual totals kWh/year													
Space heating fuel - main system												3003.1134	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2635.6951	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3003.1134	3.4800	104.5083	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9085	3.4800	30.5512	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			90.8010	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3056	(257)
SAP value	95.7365	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3003.1134	0.2160	648.6725	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9085	0.2160	189.6282	(264)
Space and water heating			838.3007	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			191.9761	(272)
CO2 emissions per m2			2.4100	(273)
EI value			97.9384	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3147	(H8)
Utilisation factor												0.5326	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-859.2180	(H17)
Solar input -26.4463	-39.7487	-66.9419	-92.5342	-111.4423	-117.2882	-114.4719	-102.2241	-79.7862	-54.2771	-32.1462	-21.9109	(63)	
										Solar input (sum of months) = Sum(63)m =	-859.2180	(63)	
Output from w/h													
138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)	
										Total per year (kWh/year) = Sum(64)m =	777.5864	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	11.9814	0.4600	0.0000	0.7700	3.0556	(74)
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	102.4811	180.2549	293.0837	440.7208	526.9157	577.7640	543.8802	477.1050	369.4988	228.3047	130.8756	83.4858	(83)
Total gains	656.4736	729.8448	821.2932	935.8174	988.1386	1008.6522	957.0528	898.5589	810.0221	702.1524	641.7401	622.3278	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9646	0.9489	0.9077	0.8132	0.6601	0.4456	0.3008	0.3278	0.6020	0.8513	0.9426	0.9691	(86)
MIT	19.4841	19.6784	20.0596	20.5049	20.8194	20.9666	20.9937	20.9916	20.9037	20.5089	19.9437	19.4583	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9573	0.9386	0.8888	0.7763	0.5966	0.3585	0.1995	0.2220	0.5137	0.8122	0.9289	0.9627	(89)
MIT 2	17.9412	18.2224	18.7609	19.3707	19.7611	19.9192	19.9351	19.9391	19.8680	19.3970	18.6157	17.9120	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2599	18.5232	19.0292	19.6050	19.9797	20.1356	20.1538	20.1565	20.0819	19.6267	18.8900	18.2314	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1099	18.3732	18.8792	19.4550	19.8297	19.9856	20.0038	20.0065	19.9319	19.4767	18.7400	18.0814	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9404	0.9189	0.8661	0.7575	0.5902	0.3624	0.2060	0.2286	0.5130	0.7920	0.9085	0.9471	(94)
Useful gains	617.3522	670.6360	711.3103	708.9143	583.2015	365.5729	197.1146	205.4082	415.5588	556.1168	583.0523	589.3977	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1252.2149	1221.9016	1098.1108	906.1066	647.6658	373.9457	197.8911	206.5124	443.9681	742.8744	1012.9249	1234.5406	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)

Space heating 2248.9500 (98)
Space heating per m2 (98) / (4) = 28.1894 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2485.0276 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	521.9202	409.3376	317.9885	156.8823	52.9960	0.0000	0.0000	0.0000	0.0000	153.5333	341.9981	530.3716	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7531	89.7728	89.7604	89.7783	89.6554	87.3000	87.3000	87.3000	87.3000	89.2748	89.6036	89.7633	(217)
Fuel for water heating, kWh/month	154.5546	117.0650	92.9629	44.4258	18.5034	0.0000	0.0000	18.7735	45.4125	93.1521	129.6679	154.2675	(219)

Water heating fuel used 868.7852 (219)
Annual totals kWh/year
Space heating fuel - main system 2485.0276 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 356.9126 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596 -1824.1596 (233)
Total delivered energy for all uses 2011.5658 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2485.0276	3.9200	97.4131	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.7852	3.9200	34.0564	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-8.1756	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2485.0276	0.2160	536.7660	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.7852	0.2160	187.6576	(264)
Space and water heating			724.4236	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			27.7974	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2485.0276	1.2200	3031.7337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.7852	1.2200	1059.9180	(264)
Space and water heating			4091.6517	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-29.0466	(272)
Primary energy kWh/m2/year			-0.3641	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.7200	81.1852	0.4600	0.0000	0.9000	24.1997
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						635.7041

	Jun	Jul	Aug	
Solar gains	675	636	558	(P4)
Internal gains	428	410	418	
Total summer gains	1103	1046	976	(P5)
Summer gain/loss ratio	3.36	3.19	2.97	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.31	22.03	21.72	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-350	**Issued on Date**	19/10/2022
Assessment Reference	Plot 350	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	Plot 350, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.34	**TER**	18.71
Environmental	86 B	**% DER<TER**	7.30		
CO_2 Emissions (t/year)	1.15	**DFEE**	46.56	**TFEE**	53.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.37		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.71 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.34 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.6 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 5.06 m², No overhang
Windows facing South: 0.72 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	473.6848	562.7715	665.2376	775.8349	847.5725	837.1112	797.9449	733.9616	650.5315	542.9455	467.3250	445.2959	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9877	0.9778	0.9541	0.8957	0.7895	0.6359	0.4937	0.5472	0.7746	0.9354	0.9799	0.9899	(86)
MIT	19.0093	19.2546	19.6682	20.1953	20.6138	20.8705	20.9585	20.9413	20.7356	20.1622	19.4958	18.9778	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9850	0.9730	0.9439	0.8721	0.7416	0.5549	0.3854	0.4375	0.7060	0.9157	0.9748	0.9877	(89)
MIT 2	17.2373	17.5951	18.1928	18.9459	19.5056	19.8219	19.9045	19.8954	19.6790	18.9181	17.9589	17.1999	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6034	17.9379	18.4976	19.2040	19.7345	20.0385	20.1222	20.1114	19.8972	19.1751	18.2764	17.5671	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4534	17.7879	18.3476	19.0540	19.5845	19.8885	19.9722	19.9614	19.7472	19.0251	18.1264	17.4171	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9759	0.9597	0.9244	0.8491	0.7251	0.5518	0.3903	0.4411	0.6932	0.8942	0.9623	0.9799	(94)
Useful gains	462.2877	540.0770	614.9569	658.7438	614.5691	461.8970	311.4144	323.7163	450.9390	485.4776	449.6866	436.3361	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1305.5977	1274.5708	1167.4672	983.6096	761.3002	502.9427	320.6978	337.7344	540.2214	813.4986	1071.6426	1293.3035	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.4226	493.5799	411.0677	233.9034	109.1680	0.0000	0.0000	0.0000	0.0000	244.0476	447.8084	637.5837	(98)
Space heating												3204.5812	(98)
Space heating per m2											(98) / (4) =	40.1677	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3540.9737	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	627.4226	493.5799	411.0677	233.9034	109.1680	0.0000	0.0000	0.0000	0.0000	244.0476	447.8084	637.5837	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	693.2846	545.3921	454.2184	258.4568	120.6276	0.0000	0.0000	0.0000	0.0000	269.6659	494.8159	704.5124	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8140	89.7536	89.6201	89.3165	88.7442	87.3000	87.3000	87.3000	87.3000	89.3205	89.6820	89.8381	(217)
Fuel for water heating, kWh/month													
	183.8956	161.3765	167.8037	148.2581	144.2704	128.1956	120.4190	135.8687	136.8056	153.8712	165.3990	178.5283	(219)
Water heating fuel used												1824.6916	(219)
Annual totals kWh/year													
Space heating fuel - main system												3540.9737	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5797.5779	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3540.9737	0.2160	764.8503	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.6916	0.2160	394.1334	(264)
Space and water heating			1158.9837	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1383.1464	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.3400	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.8363	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.8363	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	472.4332	548.6961	634.6280	726.4452	784.6852	772.1171	736.4376	682.6777	612.8588	523.6690	462.5036	446.4014	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9981	0.9957	0.9875	0.9564	0.8690	0.7017	0.5339	0.5929	0.8475	0.9776	0.9961	0.9986	(86)
MIT	19.7027	19.8613	20.1362	20.4976	20.7902	20.9494	20.9896	20.9828	20.8656	20.4708	20.0230	19.6801	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9975	0.9942	0.9830	0.9399	0.8215	0.6097	0.4144	0.4703	0.7753	0.9662	0.9945	0.9981	(89)
MIT 2	18.2035	18.4369	18.8381	19.3610	19.7477	19.9306	19.9602	19.9592	19.8512	19.3338	18.6834	18.1783	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9918	0.9781	0.9329	0.8221	0.6266	0.4392	0.4956	0.7835	0.9604	0.9922	0.9971	(94)
Useful gains	470.6160	544.1708	620.7324	677.7332	645.0818	483.7864	323.4325	338.3126	480.1711	502.9476	458.9157	445.0921	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1345.5016	1305.3554	1186.2018	992.2814	764.5404	506.3037	326.4608	343.7277	547.2975	829.8296	1103.3045	1336.6943	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating												3269.0044	(98)
Space heating per m2											(98) / (4) =	40.9752	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3500.0047	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	696.9110	547.6618	450.4382	242.4783	95.1577	0.0000	0.0000	0.0000	0.0000	260.3857	496.7451	710.2270	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7850	87.5653	87.0623	85.8702	83.6596	80.3000	80.3000	80.3000	80.3000	85.9298	87.2930	87.8671	(217)
Fuel for water heating, kWh/month													
	230.1120	202.4549	211.8581	190.5162	189.3271	173.7253	166.4421	185.5439	187.5930	199.6169	209.7595	224.4729	(219)
Water heating fuel used												2371.4221	(219)
Annual totals kWh/year													
Space heating fuel - main system												3500.0047	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6303.3394	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3500.0047	0.2160	756.0010	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.4221	0.2160	512.2272	(264)
Space and water heating			1268.2282	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1492.3908	(272)
Emissions per m2 for space and water heating			15.8966	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8966 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.7100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	441.5784	531.4431	635.5241	748.3146	821.4770	813.0195	775.5536	709.3885	625.1809	515.3254	437.1418	413.9621	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9899	0.9810	0.9586	0.9023	0.7975	0.6448	0.5015	0.5581	0.7864	0.9425	0.9833	0.9919	(86)
MIT	18.9993	19.2455	19.6610	20.1875	20.6099	20.8680	20.9578	20.9393	20.7277	20.1450	19.4762	18.9624	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9877	0.9768	0.9494	0.8799	0.7508	0.5644	0.3930	0.4481	0.7198	0.9247	0.9790	0.9901	(89)
MIT 2	18.0813	18.3275	18.7388	19.2563	19.6438	19.8639	19.9218	19.9152	19.7609	19.2285	18.5683	18.0528	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2709	18.5171	18.9293	19.4487	19.8434	20.0713	20.1358	20.1268	19.9606	19.4178	18.7559	18.2407	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2709	18.5171	18.9293	19.4487	19.8434	20.0713	20.1358	20.1268	19.9606	19.4178	18.7559	18.2407	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9697	0.9387	0.8681	0.7468	0.5753	0.4142	0.4688	0.7218	0.9140	0.9726	0.9862	(94)
Useful gains	434.1460	515.3448	596.5714	649.6054	613.4907	467.7286	321.2535	332.5822	451.2293	471.0109	425.1732	408.2433	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1359.8031	1321.4424	1202.6597	1006.6946	775.1275	514.4690	332.4686	349.6304	553.6811	839.3232	1115.3188	1350.8858	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.6889	541.6975	450.9297	257.1042	120.2578	0.0000	0.0000	0.0000	0.0000	274.0244	496.9048	701.3259	(98)
Space heating												3530.9332	(98)
Space heating per m2											(98) / (4) =	44.2584	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8301	0.8864	0.8587	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	733.7453	616.7913	612.2297	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1042.2160	996.5510	920.8390	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	222.0989	282.5412	229.6053	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												734.2454	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.5247	70.6353	57.4013	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												183.5613	(107)
Space cooling per m2												2.3008	(108)
Energy for space heating												44.2584	(99)
Energy for space cooling												2.3008	(108)
Total												46.5592	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	427.9478	505.2996	593.4688	688.0993	748.3884	738.4467	704.4605	647.8968	576.6729	484.5933	420.2468	402.6847	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9988	0.9970	0.9906	0.9643	0.8855	0.7247	0.5557	0.6199	0.8706	0.9836	0.9975	0.9991	(86)
MIT	19.6511	19.8115	20.0908	20.4609	20.7676	20.9415	20.9876	20.9791	20.8452	20.4293	19.9743	19.6291	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9984	0.9960	0.9871	0.9503	0.8414	0.6329	0.4326	0.4940	0.8037	0.9749	0.9964	0.9988	(89)
MIT 2	18.7000	18.8623	19.1420	19.5138	19.7950	19.9372	19.9609	19.9602	19.8718	19.4906	19.0360	18.6870	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9844	0.9463	0.8435	0.6502	0.4582	0.5202	0.8123	0.9719	0.9954	0.9984	(94)
Useful gains	427.0023	502.6483	584.2200	651.1352	631.2473	480.1137	322.8104	337.0254	468.4464	470.9619	418.2956	402.0272	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1381.7863	1336.2379	1208.0068	1002.8277	767.5815	506.6286	326.4703	343.7342	548.4112	840.5503	1128.3900	1373.4673	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	710.3593	560.1722	464.0973	253.2186	101.4326	0.0000	0.0000	0.0000	0.0000	274.9738	511.2679	722.7515	(98)
Space heating												3598.2733	(98)
Space heating per m2											(98) / (4) =	45.1024	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8754	0.9319	0.9069	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	751.9115	630.1425	628.3249	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	955.0530	913.4552	848.9656	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	146.2619	210.7847	164.1567	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												521.2033	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   36.5655   52.6962   41.0392    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        130.3008 (107)
Space cooling per m2                                                                                                   1.6333 (108)
Energy for space heating                                                                                              45.1024 (99)
Energy for space cooling                                                                                               1.6333 (108)
Total                                                                                                                 46.7357 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                53.7 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	112.4279	194.0642	308.1016	453.8349	536.0123	585.0267	551.7912	488.5037	384.9528	243.5239	142.7801	92.1059	(83)
Total gains	666.4204	743.6542	836.3110	948.9315	997.2353	1015.9149	964.9639	909.9575	825.4761	717.3716	653.6447	630.9479	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area	0.9631	0.9464	0.9038	0.8083	0.6561	0.4428	0.2984	0.3239	0.5936	0.8447	0.9398	0.9679	(86)
MIT	19.4987	19.6975	20.0771	20.5152	20.8228	20.9672	20.9938	20.9919	20.9077	20.5229	19.9597	19.4712	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house	0.9556	0.9356	0.8843	0.7710	0.5925	0.3561	0.1979	0.2192	0.5057	0.8047	0.9256	0.9613	(89)
MIT 2	17.9619	18.2492	18.7847	19.3834	19.7645	19.9197	19.9351	19.9392	19.8713	19.4143	18.6379	17.9304	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2794	18.5484	19.0516	19.6172	19.9831	20.1360	20.1538	20.1567	20.0854	19.6433	18.9110	18.2487	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1294	18.3984	18.9016	19.4672	19.8331	19.9860	20.0038	20.0067	19.9354	19.4933	18.7610	18.0987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9156	0.8615	0.7525	0.5864	0.3601	0.2043	0.2258	0.5053	0.7849	0.9050	0.9454	(94)
Useful gains	625.3443	680.8910	720.5032	714.0985	584.7539	365.7809	197.1403	205.4629	417.1305	563.0319	591.5520	596.4850	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.0885	1224.3072	1100.2621	907.2685	647.9911	373.9881	197.8972	206.5252	444.2923	744.4443	1014.9014	1236.1838	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)

Space heating 2217.3511 (98)
RHI space heating demand 2217 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)

Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124 (83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9699	0.9540	0.9198	0.8460	0.7274	0.5687	0.4317	0.4755	0.6936	0.8843	0.9543	0.9740	(86)
MIT	19.2868	19.5156	19.8915	20.3560	20.7048	20.9077	20.9722	20.9615	20.8150	20.3467	19.7436	19.2536	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9638	0.9448	0.9038	0.8155	0.6749	0.4900	0.3335	0.3750	0.6193	0.8543	0.9437	0.9687	(89)
MIT 2	17.6371	17.9675	18.5038	19.1562	19.6101	19.8544	19.9122	19.9079	19.7596	19.1629	18.3111	17.5983	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	17.9779	18.2873	18.7905	19.4041	19.8362	20.0720	20.1312	20.1255	19.9776	19.4074	18.6070	17.9402	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8279	18.1373	18.6405	19.2541	19.6862	19.9220	19.9812	19.9755	19.8276	19.2574	18.4570	17.7902	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9254	0.8808	0.7940	0.6628	0.4897	0.3387	0.3795	0.6122	0.8318	0.9244	0.9543	(94)
Useful gains	619.3735	684.9717	735.3038	741.6538	658.8749	477.2300	315.4791	330.1048	486.1577	580.5113	586.1192	592.6631	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1342.7747	1309.1222	1196.3302	1002.9887	771.1227	506.1231	321.5518	339.0699	547.9092	835.9284	1103.7746	1329.8091	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)

Space heating 2683.4957 (98)

Space heating per m2 (98) / (4) = 33.6362 (99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2965.1886	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	594.7077	463.4576	379.0095	207.9129	92.2789	0.0000	0.0000	0.0000	0.0000	209.9783	411.8364	606.0073	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7277	89.6564	89.5001	89.1502	88.5359	87.3000	87.3000	87.3000	87.3000	89.1288	89.5654	89.7556	(217)
Fuel for water heating, kWh/month													
	184.0724	161.5514	168.0288	148.5347	144.6099	128.1956	120.4190	135.8687	136.8056	154.2020	165.6145	178.6925	(219)
Water heating fuel used												1826.5950	(219)
Annual totals kWh/year													
Space heating fuel - main system												2965.1886	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5223.6962	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2965.1886	3.4800	103.1886	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.5950	3.4800	63.5655	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			343.7233	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1569	(257)
SAP value		83.8606	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2965.1886	0.2160	640.4807	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.5950	0.2160	394.5445	(264)
Space and water heating			1035.0252	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1259.1879	(272)
CO2 emissions per m2			15.7800	(273)
EI value			86.4777	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	112.4279	194.0642	308.1016	453.8349	536.0123	585.0267	551.7912	488.5037	384.9528	243.5239	142.7801	92.1059	(83)
Total gains	666.4204	743.6542	836.3110	948.9315	997.2353	1015.9149	964.9639	909.9575	825.4761	717.3716	653.6447	630.9479	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9631	0.9464	0.9038	0.8083	0.6561	0.4428	0.2984	0.3239	0.5936	0.8447	0.9398	0.9679	(86)
MIT	19.4987	19.6975	20.0771	20.5152	20.8228	20.9672	20.9938	20.9919	20.9077	20.5229	19.9597	19.4712	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9556	0.9356	0.8843	0.7710	0.5925	0.3561	0.1979	0.2192	0.5057	0.8047	0.9256	0.9613	(89)
MIT 2	17.9619	18.2492	18.7847	19.3834	19.7645	19.9197	19.9351	19.9392	19.8713	19.4143	18.6379	17.9304	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2794	18.5484	19.0516	19.6172	19.9831	20.1360	20.1538	20.1567	20.0854	19.6433	18.9110	18.2487	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1294	18.3984	18.9016	19.4672	19.8331	19.9860	20.0038	20.0067	19.9354	19.4933	18.7610	18.0987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9156	0.8615	0.7525	0.5864	0.3601	0.2043	0.2258	0.5053	0.7849	0.9050	0.9454	(94)
Useful gains	625.3443	680.8910	720.5032	714.0985	584.7539	365.7809	197.1403	205.4629	417.1305	563.0319	591.5520	596.4850	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.0885	1224.3072	1100.2621	907.2685	647.9911	373.9881	197.8972	206.5252	444.2923	744.4443	1014.9014	1236.1838	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating												2217.3511	(98)
Space heating per m2											(98) / (4) =	27.7933	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2450.1118	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	516.8902	403.5090	312.1996	153.6822	51.9873	0.0000	0.0000	0.0000	0.0000	149.1390	336.8084	525.8961	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6426	89.5676	89.3622	88.9105	88.1375	87.3000	87.3000	87.3000	87.3000	88.8567	89.4270	89.6715	(217)
Fuel for water heating, kWh/month													
	184.2472	161.7116	168.2881	148.9352	145.2635	128.1956	120.4190	135.8687	136.8056	154.6742	165.8707	178.8600	(219)
Water heating fuel used												1829.1394	(219)
Annual totals kWh/year													
Space heating fuel - main system												2450.1118	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4711.1638	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2450.1118	3.9200	96.0444	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1829.1394	3.9200	71.7023	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			328.9990	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2450.1118	0.2160	529.2241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.1394	0.2160	395.0941	(264)
Space and water heating			924.3182	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1148.4809	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2450.1118	1.2200	2989.1364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.1394	1.2200	2231.5500	(264)
Space and water heating			5220.6864	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6546.6582	(272)
Primary energy kWh/m2/year			82.0589	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.8%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£256	£218	£38
Space heating	£197	£197	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£329	-£9	£339
Total cost of uses	£330	-£8	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	82 kWh/m²	-1 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9699	0.9540	0.9198	0.8460	0.7274	0.5687	0.4317	0.4755	0.6936	0.8843	0.9543	0.9740	(86)
MIT	19.2868	19.5156	19.8915	20.3560	20.7048	20.9077	20.9722	20.9615	20.8150	20.3467	19.7436	19.2536	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9638	0.9448	0.9038	0.8155	0.6749	0.4900	0.3335	0.3750	0.6193	0.8543	0.9437	0.9687	(89)
MIT 2	17.6371	17.9675	18.5038	19.1562	19.6101	19.8544	19.9122	19.9079	19.7596	19.1629	18.3111	17.5983	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	17.9779	18.2873	18.7905	19.4041	19.8362	20.0720	20.1312	20.1255	19.9776	19.4074	18.6070	17.9402	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8279	18.1373	18.6405	19.2541	19.6862	19.9220	19.9812	19.9755	19.8276	19.2574	18.4570	17.7902	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9254	0.8808	0.7940	0.6628	0.4897	0.3387	0.3795	0.6122	0.8318	0.9244	0.9543	(94)
Useful gains	619.3735	684.9717	735.3038	741.6538	658.8749	477.2300	315.4791	330.1048	486.1577	580.5113	586.1192	592.6631	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1342.7747	1309.1222	1196.3302	1002.9887	771.1227	506.1231	321.5518	339.0699	547.9092	835.9284	1103.7746	1329.8091	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)
Space heating												2683.4957	(98)
Space heating per m2											(98) / (4) =	33.6362	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2965.1886	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	594.7077	463.4576	379.0095	207.9129	92.2789	0.0000	0.0000	0.0000	0.0000	209.9783	411.8364	606.0073	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8177	89.8455	89.8714	89.9309	90.0568	87.3000	87.3000	87.3000	87.3000	89.4841	89.7026	89.8307	(217)
Fuel for water heating, kWh/month	156.6586	115.7875	89.9946	43.6632	14.3797	0.0000	0.0000	24.1300	49.2919	95.2868	133.0217	155.7601	(219)
Water heating fuel used												877.9742	(219)
Annual totals kWh/year													
Space heating fuel - main system												2965.1886	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2597.8360	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2965.1886	3.4800	103.1886	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9742	3.4800	30.5535	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			89.4835	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3012	(257)
SAP value	95.7983	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2965.1886	0.2160	640.4807	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9742	0.2160	189.6424	(264)
Space and water heating			830.1232	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			183.7986	(272)
CO2 emissions per m2			2.3000	(273)
EI value			98.0262	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3147	(H8)
Utilisation factor												0.5326	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-859.2180	(H17)
Solar input	-26.4463	-39.7487	-66.9419	-92.5342	-111.4423	-117.2882	-114.4719	-102.2241	-79.7862	-54.2771	-32.1462	-21.9109	(63)
											Solar input (sum of months) = Sum(63)m =	-859.2180	(63)
Output from w/h													
	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
											Total per year (kWh/year) = Sum(64)m =	777.5864	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	112.4279	194.0642	308.1016	453.8349	536.0123	585.0267	551.7912	488.5037	384.9528	243.5239	142.7801	92.1059	(83)
Total gains	666.4204	743.6542	836.3110	948.9315	997.2353	1015.9149	964.9639	909.9575	825.4761	717.3716	653.6447	630.9479	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9631	0.9464	0.9038	0.8083	0.6561	0.4428	0.2984	0.3239	0.5936	0.8447	0.9398	0.9679	(86)
MIT	19.4987	19.6975	20.0771	20.5152	20.8228	20.9672	20.9938	20.9919	20.9077	20.5229	19.9597	19.4712	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9556	0.9356	0.8843	0.7710	0.5925	0.3561	0.1979	0.2192	0.5057	0.8047	0.9256	0.9613	(89)
MIT 2	17.9619	18.2492	18.7847	19.3834	19.7645	19.9197	19.9351	19.9392	19.8713	19.4143	18.6379	17.9304	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2794	18.5484	19.0516	19.6172	19.9831	20.1360	20.1538	20.1567	20.0854	19.6433	18.9110	18.2487	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1294	18.3984	18.9016	19.4672	19.8331	19.9860	20.0038	20.0067	19.9354	19.4933	18.7610	18.0987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9156	0.8615	0.7525	0.5864	0.3601	0.2043	0.2258	0.5053	0.7849	0.9050	0.9454	(94)
Useful gains	625.3443	680.8910	720.5032	714.0985	584.7539	365.7809	197.1403	205.4629	417.1305	563.0319	591.5520	596.4850	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.0885	1224.3072	1100.2621	907.2685	647.9911	373.9881	197.8972	206.5252	444.2923	744.4443	1014.9014	1236.1838	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating												2217.3511	(98)
Space heating per m2											(98) / (4) =	27.7933	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2450.1118	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	516.8902	403.5090	312.1996	153.6822	51.9873	0.0000	0.0000	0.0000	0.0000	149.1390	336.8084	525.8961	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7476	89.7647	89.7499	89.7667	89.6434	87.3000	87.3000	87.3000	87.3000	89.2527	89.5937	89.7585	(217)
Fuel for water heating, kWh/month	154.5642	117.0755	92.9738	44.4316	18.5059	0.0000	0.0000	18.7735	45.4125	93.1751	129.6822	154.2757	(219)
Water heating fuel used												868.8700	(219)

Annual totals kWh/year		
Space heating fuel - main system	2450.1118	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	1976.7348	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2450.1118	3.9200	96.0444	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.8700	3.9200	34.0597	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-9.5410	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2450.1118	0.2160	529.2241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8700	0.2160	187.6759	(264)
Space and water heating			716.9001	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			20.2739	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2450.1118	1.2200	2989.1364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8700	1.2200	1060.0214	(264)
Space and water heating			4049.1578	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-71.5405	(272)
Primary energy kWh/m2/year			-0.8967	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
South	0.7200	112.2060	0.4600	0.0000	0.9000	33.4464
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						644.9508

	Jun	Jul	Aug	
Solar gains	684	645	571	(P4)
Internal gains	428	410	418	
Total summer gains	1112	1055	989	(P5)
Summer gain/loss ratio	3.39	3.22	3.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.33	22.06	21.76	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-351	**Issued on Date**	19/10/2022
Assessment Reference	Plot 351	**Prop Type Ref**	Badlesmere-As-SEMI
Property	Plot 351, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.46	**TER**	18.83
Environmental	86 B	**% DER<TER**	7.28		
CO_2 Emissions (t/year)	1.16	**DFEE**	47.07	**TFEE**	54.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.43		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.83 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.46 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.1 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 0.72 m², No overhang
Windows facing East: 5.06 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	464.4736	548.4272	649.1701	761.8673	837.3320	829.3170	789.4436	722.3202	635.1359	528.0531	456.5376	437.2541	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9884	0.9793	0.9569	0.8998	0.7940	0.6400	0.4982	0.5542	0.7836	0.9396	0.9812	0.9904	(86)
MIT	18.9946	19.2325	19.6455	20.1796	20.6064	20.8679	20.9574	20.9391	20.7251	20.1425	19.4790	18.9648	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9858	0.9748	0.9472	0.8769	0.7465	0.5590	0.3892	0.4437	0.7161	0.9211	0.9764	0.9883	(89)
MIT 2	17.2160	17.5634	18.1609	18.9249	19.4969	19.8196	19.9038	19.8939	19.6678	18.8914	17.9347	17.1810	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.5834	17.9081	18.4675	19.1841	19.7261	20.0362	20.1214	20.1098	19.8862	19.1498	18.2537	17.5495	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4334	17.7581	18.3175	19.0341	19.5761	19.8862	19.9714	19.9598	19.7362	18.9998	18.1037	17.3995	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9621	0.9283	0.8539	0.7296	0.5557	0.3940	0.4471	0.7026	0.8999	0.9643	0.9808	(94)
Useful gains	453.8395	527.6261	602.5923	650.5524	610.9538	460.8151	311.0728	322.9808	446.2153	475.1715	440.2531	428.8628	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1303.6182	1271.6260	1164.5084	981.6781	760.4865	502.7159	320.6259	337.5799	539.1708	811.0570	1069.4411	1291.5757	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	632.2354	499.9679	418.0656	238.4105	111.2523	0.0000	0.0000	0.0000	0.0000	249.8988	453.0153	641.8584	(98)
Space heating												3244.7042	(98)
Space heating per m2											(98) / (4) =	40.6706	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3585.3085	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	632.2354	499.9679	418.0656	238.4105	111.2523	0.0000	0.0000	0.0000	0.0000	249.8988	453.0153	641.8584	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	698.6026	552.4507	461.9509	263.4370	122.9307	0.0000	0.0000	0.0000	0.0000	276.1313	500.5694	709.2358	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8181	89.7609	89.6308	89.3307	88.7592	87.3000	87.3000	87.3000	87.3000	89.3380	89.6891	89.8416	(217)
Fuel for water heating, kWh/month													
	183.8872	161.3633	167.7836	148.2345	144.2461	128.1956	120.4190	135.8687	136.8056	153.8409	165.3861	178.5214	(219)
Water heating fuel used												1824.5518	(219)
Annual totals kWh/year													
Space heating fuel - main system												3585.3085	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Total delivered energy for all uses	5841.7730	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3585.3085	0.2160	774.4266	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.5518	0.2160	394.1032	(264)
Space and water heating			1168.5298	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1392.6925	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.4600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.4600	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.9563	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.9563	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	464.4856	536.3195	620.7647	714.3935	775.8493	765.3921	729.1025	672.6332	599.5751	510.8194	453.1960	439.4627	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9983	0.9961	0.9886	0.9590	0.8731	0.7063	0.5388	0.6005	0.8561	0.9797	0.9965	0.9987	(86)
MIT	19.6935	19.8471	20.1210	20.4862	20.7849	20.9479	20.9891	20.9819	20.8584	20.4573	20.0123	19.6720	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9977	0.9948	0.9845	0.9433	0.8264	0.6143	0.4184	0.4769	0.7857	0.9692	0.9950	0.9982	(89)
MIT 2	18.1901	18.4163	18.8162	19.3456	19.7417	19.9295	19.9600	19.9587	19.8442	19.3151	18.6679	18.1665	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5006	18.7118	19.0858	19.5813	19.9571	20.1399	20.1726	20.1701	20.0537	19.5510	18.9456	18.4775	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9925	0.9798	0.9363	0.8266	0.6310	0.4434	0.5024	0.7932	0.9637	0.9929	0.9973	(94)
Useful gains	462.8205	532.2798	608.2253	668.9029	641.3404	482.9731	323.2806	337.9245	475.5798	492.2513	449.9570	438.2566	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1344.3128	1303.5374	1184.2759	990.9332	763.9970	506.1960	326.4405	343.6765	546.6508	828.1996	1101.9511	1335.6629	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating												3312.8667	(98)
Space heating per m2											(98) / (4) =	41.5250	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3546.9665	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	655.8303	518.2851	428.5816	231.8618	91.2565	0.0000	0.0000	0.0000	0.0000	249.9456	469.4357	667.6702	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	702.1737	554.9091	458.8669	248.2460	97.7050	0.0000	0.0000	0.0000	0.0000	267.6077	502.6078	714.8504	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7995	87.5920	87.1036	85.9289	83.7191	80.3000	80.3000	80.3000	80.3000	85.9979	87.3182	87.8793	(217)
Fuel for water heating, kWh/month													
	230.0739	202.3931	211.7577	190.3861	189.1926	173.7253	166.4421	185.5439	187.5930	199.4590	209.6990	224.4415	(219)
Water heating fuel used												2370.7072	(219)
Annual totals kWh/year													
Space heating fuel - main system												3546.9665	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6349.5864	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3546.9665	0.2160	766.1448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.7072	0.2160	512.0728	(264)
Space and water heating			1278.2175	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1502.3802	(272)
Emissions per m2 for space and water heating			16.0218	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0218 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	432.3673	517.0988	619.4567	734.3470	811.2364	805.2253	767.0523	697.7471	609.7854	500.4330	426.3545	405.9203	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9906	0.9824	0.9613	0.9064	0.8020	0.6491	0.5061	0.5654	0.7956	0.9466	0.9845	0.9923	(86)
MIT	18.9844	19.2231	19.6379	20.1713	20.6022	20.8653	20.9566	20.9369	20.7166	20.1247	19.4591	18.9493	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9885	0.9785	0.9526	0.8847	0.7558	0.5686	0.3970	0.4547	0.7301	0.9299	0.9805	0.9906	(89)
MIT 2	18.0665	18.3054	18.7164	19.2414	19.6376	19.8623	19.9213	19.9142	19.7528	19.2095	18.5515	18.0397	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2561	18.4949	18.9068	19.4335	19.8369	20.0694	20.1352	20.1254	19.9519	19.3985	18.7390	18.2276	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2561	18.4949	18.9068	19.4335	19.8369	20.0694	20.1352	20.1254	19.9519	19.3985	18.7390	18.2276	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9718	0.9422	0.8728	0.7515	0.5794	0.4183	0.4754	0.7315	0.9193	0.9743	0.9869	(94)
Useful gains	425.4934	502.4941	583.6729	640.9683	609.6506	466.5467	320.8603	331.7278	446.0400	460.0696	415.4177	400.6090	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1358.3612	1319.2880	1200.4794	1005.2509	774.5094	514.2908	332.4100	349.5030	552.8575	837.4920	1113.7017	1349.6264	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	694.0537	548.8855	458.9041	262.2835	122.6549	0.0000	0.0000	0.0000	0.0000	280.8023	502.7645	706.0690	(98)
Space heating												3576.4174	(98)
Space heating per m2											(98) / (4) =	44.8285	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8272	0.8839	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	731.1867	615.0314	609.0983	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1033.1059	986.6144	907.2322	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	217.3819	276.4577	221.8116	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												715.6512	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	54.3455	69.1144	55.4529	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												178.9128	(107)
Space cooling per m2												2.2426	(108)
Energy for space heating												44.8285	(99)
Energy for space cooling												2.2426	(108)
Total												47.0711	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.6300	0.7000	0.7700	2.3398	(74)
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	77.7889	152.0660	250.6653	366.7035	450.8925	462.3389	439.8414	376.7391	291.8326	180.4561	96.9627	63.9963	(83)
Total gains	420.0002	492.9230	579.6054	676.0477	739.5525	731.7217	697.1254	637.8524	563.3892	471.7437	410.9391	395.7460	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9989	0.9973	0.9915	0.9666	0.8894	0.7293	0.5609	0.6280	0.8788	0.9853	0.9977	0.9992	(86)
MIT	19.6419	19.7972	20.0753	20.4491	20.7617	20.9398	20.9870	20.9779	20.8371	20.4154	19.9635	19.6210	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9985	0.9964	0.9883	0.9533	0.8461	0.6376	0.4369	0.5012	0.8142	0.9774	0.9967	0.9989	(89)
MIT 2	18.6908	18.8481	19.1268	19.5028	19.7904	19.9363	19.9607	19.9598	19.8661	19.4773	19.0252	18.6789	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8873	19.0441	19.3227	19.6983	19.9910	20.1436	20.1727	20.1701	20.0667	19.6711	19.2191	18.8735	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9953	0.9858	0.9493	0.8480	0.6548	0.4628	0.5276	0.8221	0.9745	0.9958	0.9985	(94)
Useful gains	419.1443	490.5901	571.3602	641.7939	627.1262	479.1676	322.6256	336.5415	463.1510	459.7196	409.2036	395.1474	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1380.9137	1334.8978	1206.5707	1001.7884	767.1336	506.5306	326.4500	343.6823	547.8447	839.3066	1127.3915	1372.7109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	715.5564	567.3748	472.5966	259.1960	104.1655	0.0000	0.0000	0.0000	0.0000	282.4127	517.0953	727.3073	(98)
Space heating												3645.7045	(98)
Space heating per m2											(98) / (4) =	45.6970	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8725	0.9298	0.9028	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	749.3878	628.6644	625.4848	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	947.1926	904.8817	837.2253	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	142.4195	205.5057	157.5349	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												505.4600	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   35.6049   51.3764   39.3837    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        126.3650 (107)
Space cooling per m2                                                                                                   1.5839 (108)
Energy for space heating                                                                                              45.6970 (99)
Energy for space cooling                                                                                               1.5839 (108)
Total                                                                                                                 47.2809 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                54.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
RHI water heating demand												1622	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	11.9814	0.4600	0.0000	0.7700	3.0556	(74)
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	102.4811	180.2549	293.0837	440.7208	526.9157	577.7640	543.8802	477.1050	369.4988	228.3047	130.8756	83.4858	(83)
Total gains	656.4736	729.8448	821.2932	935.8174	988.1386	1008.6522	957.0528	898.5589	810.0221	702.1524	641.7401	622.3278	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9646	0.9489	0.9077	0.8132	0.6601	0.4456	0.3008	0.3278	0.6020	0.8513	0.9426	0.9691	(86)
MIT	19.4841	19.6784	20.0596	20.5049	20.8194	20.9666	20.9937	20.9916	20.9037	20.5089	19.9437	19.4583	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9573	0.9386	0.8888	0.7763	0.5966	0.3585	0.1995	0.2220	0.5137	0.8122	0.9289	0.9627	(89)
MIT 2	17.9412	18.2224	18.7609	19.3707	19.7611	19.9192	19.9351	19.9391	19.8680	19.3970	18.6157	17.9120	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2599	18.5232	19.0292	19.6050	19.9797	20.1356	20.1538	20.1565	20.0819	19.6267	18.8900	18.2314	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1099	18.3732	18.8792	19.4550	19.8297	19.9856	20.0038	20.0065	19.9319	19.4767	18.7400	18.0814	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9404	0.9189	0.8661	0.7575	0.5902	0.3624	0.2060	0.2286	0.5130	0.7920	0.9085	0.9471	(94)
Useful gains	617.3522	670.6360	711.3103	708.9143	583.2015	365.5729	197.1146	205.4082	415.5588	556.1168	583.0523	589.3977	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1252.2149	1221.9016	1098.1108	906.1066	647.6658	373.9457	197.8911	206.5124	443.9681	742.8744	1012.9249	1234.5406	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)
Space heating												2248.9500	(98)
RHI space heating demand												2249	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	644.1484	725.8317	818.7261	920.0994	983.7992	966.7307	922.9410	858.0878	778.7521	682.9930	623.2425	613.0125	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9710	0.9562	0.9234	0.8505	0.7317	0.5723	0.4352	0.4810	0.7019	0.8897	0.9563	0.9749	(86)
MIT	19.2731	19.4954	19.8717	20.3431	20.6993	20.9060	20.9715	20.9602	20.8079	20.3306	19.7283	19.2414	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9652	0.9475	0.9080	0.8206	0.6794	0.4934	0.3364	0.3797	0.6279	0.8605	0.9460	0.9698	(89)
MIT 2	17.6175	17.9389	18.4764	19.1396	19.6039	19.8529	19.9118	19.9071	19.7526	19.1420	18.2896	17.5807	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9595	18.2605	18.7647	19.3882	19.8302	20.0705	20.1307	20.1246	19.9706	19.3875	18.5868	17.9238	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8095	18.1105	18.6147	19.2382	19.6802	19.9205	19.9807	19.9746	19.8206	19.2375	18.4368	17.7738	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9285	0.8851	0.7989	0.6670	0.4929	0.3416	0.3842	0.6203	0.8380	0.9272	0.9557	(94)
Useful gains	611.7048	673.9055	724.6924	735.0350	656.1879	476.5222	315.2792	329.6841	483.0492	572.3145	577.8465	585.8300	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1340.9446	1306.4685	1193.7856	1001.4560	770.5354	505.9777	321.5098	338.9823	547.2417	834.0059	1101.8139	1328.1995	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating												2717.8176	(98)
Space heating per m2											(98) / (4) =	34.0664	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3003.1134	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	599.5076	469.7043	385.6413	211.9592	94.0051	0.0000	0.0000	0.0000	0.0000	215.1364	416.8580	610.3015	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7324	89.6647	89.5119	89.1652	88.5500	87.3000	87.3000	87.3000	87.3000	89.1478	89.5734	89.7596	(217)
Fuel for water heating, kWh/month													
	184.0627	161.5365	168.0065	148.5097	144.5869	128.1956	120.4190	135.8687	136.8056	154.1692	165.5997	178.6845	(219)
Water heating fuel used												1826.4444	(219)
Annual totals kWh/year													
Space heating fuel - main system												3003.1134	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5261.4705	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3003.1134	3.4800	104.5083	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.4444	3.4800	63.5603	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			345.0379	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1614	(257)
SAP value		83.7989	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3003.1134	0.2160	648.6725	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.4444	0.2160	394.5120	(264)
Space and water heating			1043.1845	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1267.3471	(272)
CO2 emissions per m2			15.8900	(273)
EI value			86.3901	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	11.9814	0.4600	0.0000	0.7700	3.0556	(74)
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	102.4811	180.2549	293.0837	440.7208	526.9157	577.7640	543.8802	477.1050	369.4988	228.3047	130.8756	83.4858	(83)
Total gains	656.4736	729.8448	821.2932	935.8174	988.1386	1008.6522	957.0528	898.5589	810.0221	702.1524	641.7401	622.3278	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area	0.9646	0.9489	0.9077	0.8132	0.6601	0.4456	0.3008	0.3278	0.6020	0.8513	0.9426	0.9691	(86)
MIT	19.4841	19.6784	20.0596	20.5049	20.8194	20.9666	20.9937	20.9916	20.9037	20.5089	19.9437	19.4583	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house	0.9573	0.9386	0.8888	0.7763	0.5966	0.3585	0.1995	0.2220	0.5137	0.8122	0.9289	0.9627	(89)
MIT 2	17.9412	18.2224	18.7609	19.3707	19.7611	19.9192	19.9351	19.9391	19.8680	19.3970	18.6157	17.9120	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2599	18.5232	19.0292	19.6050	19.9797	20.1356	20.1538	20.1565	20.0819	19.6267	18.8900	18.2314	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1099	18.3732	18.8792	19.4550	19.8297	19.9856	20.0038	20.0065	19.9319	19.4767	18.7400	18.0814	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9404	0.9189	0.8661	0.7575	0.5902	0.3624	0.2060	0.2286	0.5130	0.7920	0.9085	0.9471	(94)
Useful gains	617.3522	670.6360	711.3103	708.9143	583.2015	365.5729	197.1146	205.4082	415.5588	556.1168	583.0523	589.3977	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1252.2149	1221.9016	1098.1108	906.1066	647.6658	373.9457	197.8911	206.5124	443.9681	742.8744	1012.9249	1234.5406	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)

Space heating 2248.9500 (98)
Space heating per m2 (98) / (4) = 28.1894 (99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2485.0276	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	521.9202	409.3376	317.9885	156.8823	52.9960	0.0000	0.0000	0.0000	0.0000	153.5333	341.9981	530.3716	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6486	89.5771	89.3756	88.9270	88.1494	87.3000	87.3000	87.3000	87.3000	88.8799	89.4379	89.6767	(217)
Fuel for water heating, kWh/month													
	184.2347	161.6946	168.2628	148.9076	145.2439	128.1956	120.4190	135.8687	136.8056	154.6338	165.8506	178.8496	(219)
Water heating fuel used												1828.9663	(219)
Annual totals kWh/year													
Space heating fuel - main system												2485.0276	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4745.9066	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2485.0276	3.9200	97.4131	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.9663	3.9200	71.6955	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			330.3609	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2485.0276	0.2160	536.7660	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9663	0.2160	395.0567	(264)
Space and water heating			931.8227	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1155.9854	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2485.0276	1.2200	3031.7337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9663	1.2200	2231.3389	(264)
Space and water heating			5263.0726	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6589.0444	(272)
Primary energy kWh/m2/year			82.5902	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.7%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£257	£219	£38
Space heating	£198	£198	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£330	-£8	£339
Total cost of uses	£331	-£7	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	83 kWh/m²	0 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)
Total heat required for water heating calculated for each month												
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.2449 (H8)
Utilisation factor	0.5521 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.5935 (H14)
Volume ratio Veff/V	0.8100 (H15)
Solar storage volume factor	0.9579 (H16)
Solar input	-843.3953 (H17)

Solar input -24.4568 -40.8113 -69.5064 -93.1523 -115.0818 -113.1437 -111.6485 -97.5478 -76.3995 -52.1719 -29.0093 -20.4662 (63)
Solar input (sum of months) = Sum(63)m = -843.3953 (63)
Output from w/h

	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203 (64)

Total per year (kWh/year) = Sum(64)m = 786.4412 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	10.6334	0.4600	0.0000	0.7700	2.7118	(74)
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	90.1560	176.2418	290.5166	425.0028	522.5763	535.8425	509.7684	436.6339	338.2288	209.1454	112.3780	74.1705	(83)
Total gains	644.1484	725.8317	818.7261	920.0994	983.7992	966.7307	922.9410	858.0878	778.7521	682.9930	623.2425	613.0125	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9710	0.9562	0.9234	0.8505	0.7317	0.5723	0.4352	0.4810	0.7019	0.8897	0.9563	0.9749	(86)
MIT	19.2731	19.4954	19.8717	20.3431	20.6993	20.9060	20.9715	20.9602	20.8079	20.3306	19.7283	19.2414	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9652	0.9475	0.9080	0.8206	0.6794	0.4934	0.3364	0.3797	0.6279	0.8605	0.9460	0.9698	(89)
MIT 2	17.6175	17.9389	18.4764	19.1396	19.6039	19.8529	19.9118	19.9071	19.7526	19.1420	18.2896	17.5807	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9595	18.2605	18.7647	19.3882	19.8302	20.0705	20.1307	20.1246	19.9706	19.3875	18.5868	17.9238	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8095	18.1105	18.6147	19.2382	19.6802	19.9205	19.9807	19.9746	19.8206	19.2375	18.4368	17.7738	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9496	0.9285	0.8851	0.7989	0.6670	0.4929	0.3416	0.3842	0.6203	0.8380	0.9272	0.9557	(94)
Useful gains	611.7048	673.9055	724.6924	735.0350	656.1879	476.5222	315.2792	329.6841	483.0492	572.3145	577.8465	585.8300	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1340.9446	1306.4685	1193.7856	1001.4560	770.5354	505.9777	321.5098	338.9823	547.2417	834.0059	1101.8139	1328.1995	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating												2717.8176	(98)
Space heating per m2											(98) / (4) =	34.0664	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3003.1134	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	542.5544	425.0824	349.0053	191.8231	85.0746	0.0000	0.0000	0.0000	0.0000	194.6984	377.2565	552.3229	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	599.5076	469.7043	385.6413	211.9592	94.0051	0.0000	0.0000	0.0000	0.0000	215.1364	416.8580	610.3015	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8220	89.8524	89.8802	89.9398	90.0639	87.3000	87.3000	87.3000	87.3000	89.5008	89.7098	89.8344	(217)
Fuel for water heating, kWh/month													
	156.6511	115.7786	89.9859	43.6589	14.3785	0.0000	0.0000	24.1300	49.2919	95.2690	133.0110	155.7536	(219)
Water heating fuel used												877.9085	(219)
Annual totals kWh/year													
Space heating fuel - main system												3003.1134	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2635.6951	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3003.1134	3.4800	104.5083	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9085	3.4800	30.5512	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			90.8010	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3056	(257)
SAP value	95.7365	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3003.1134	0.2160	648.6725	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9085	0.2160	189.6282	(264)
Space and water heating			838.3007	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			191.9761	(272)
CO2 emissions per m2			2.4100	(273)
EI value			97.9384	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3147	(H8)
Utilisation factor												0.5326	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-859.2180	(H17)
Solar input -26.4463	-39.7487	-66.9419	-92.5342	-111.4423	-117.2882	-114.4719	-102.2241	-79.7862	-54.2771	-32.1462	-21.9109	(63)	
										Solar input (sum of months) = Sum(63)m =	-859.2180	(63)	
Output from w/h													
138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)	
										Total per year (kWh/year) = Sum(64)m =	777.5864	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.7200	11.9814	0.4600	0.0000	0.7700	3.0556	(74)
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	102.4811	180.2549	293.0837	440.7208	526.9157	577.7640	543.8802	477.1050	369.4988	228.3047	130.8756	83.4858	(83)
Total gains	656.4736	729.8448	821.2932	935.8174	988.1386	1008.6522	957.0528	898.5589	810.0221	702.1524	641.7401	622.3278	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9646	0.9489	0.9077	0.8132	0.6601	0.4456	0.3008	0.3278	0.6020	0.8513	0.9426	0.9691	(86)
MIT	19.4841	19.6784	20.0596	20.5049	20.8194	20.9666	20.9937	20.9916	20.9037	20.5089	19.9437	19.4583	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9573	0.9386	0.8888	0.7763	0.5966	0.3585	0.1995	0.2220	0.5137	0.8122	0.9289	0.9627	(89)
MIT 2	17.9412	18.2224	18.7609	19.3707	19.7611	19.9192	19.9351	19.9391	19.8680	19.3970	18.6157	17.9120	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2599	18.5232	19.0292	19.6050	19.9797	20.1356	20.1538	20.1565	20.0819	19.6267	18.8900	18.2314	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1099	18.3732	18.8792	19.4550	19.8297	19.9856	20.0038	20.0065	19.9319	19.4767	18.7400	18.0814	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9404	0.9189	0.8661	0.7575	0.5902	0.3624	0.2060	0.2286	0.5130	0.7920	0.9085	0.9471	(94)
Useful gains	617.3522	670.6360	711.3103	708.9143	583.2015	365.5729	197.1146	205.4082	415.5588	556.1168	583.0523	589.3977	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1252.2149	1221.9016	1098.1108	906.1066	647.6658	373.9457	197.8911	206.5124	443.9681	742.8744	1012.9249	1234.5406	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)

Space heating 2248.9500 (98)
Space heating per m2 (98) / (4) = 28.1894 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2485.0276 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	472.3378	370.4505	287.7796	141.9785	47.9614	0.0000	0.0000	0.0000	0.0000	138.9476	309.5083	479.9863	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	521.9202	409.3376	317.9885	156.8823	52.9960	0.0000	0.0000	0.0000	0.0000	153.5333	341.9981	530.3716	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7531	89.7728	89.7604	89.7783	89.6554	87.3000	87.3000	87.3000	87.3000	89.2748	89.6036	89.7633	(217)
Fuel for water heating, kWh/month	154.5546	117.0650	92.9629	44.4258	18.5034	0.0000	0.0000	18.7735	45.4125	93.1521	129.6679	154.2675	(219)

Water heating fuel used 868.7852 (219)
Annual totals kWh/year
Space heating fuel - main system 2485.0276 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 356.9126 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596 -1824.1596 (233)
Total delivered energy for all uses 2011.5658 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2485.0276	3.9200	97.4131	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.7852	3.9200	34.0564	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-8.1756	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2485.0276	0.2160	536.7660	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.7852	0.2160	187.6576	(264)
Space and water heating			724.4236	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			27.7974	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2485.0276	1.2200	3031.7337	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.7852	1.2200	1059.9180	(264)
Space and water heating			4091.6517	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-29.0466	(272)
Primary energy kWh/m2/year			-0.3641	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.7200	81.1852	0.4600	0.0000	0.9000	24.1997
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						635.7041

	Jun	Jul	Aug	
Solar gains	675	636	558	(P4)
Internal gains	428	410	418	
Total summer gains	1103	1046	976	(P5)
Summer gain/loss ratio	3.36	3.19	2.97	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.31	22.03	21.72	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-352	**Issued on Date**	19/10/2022
Assessment Reference	Plot 352	**Prop Type Ref**	Badlesmere-Opp-SEMI
Property	Plot 352, 2 Bed, K, WC, Ut, B, En		

SAP Rating	84 B	**DER**	17.34	**TER**	18.71
Environmental	86 B	**% DER<TER**	7.30		
CO_2 Emissions (t/year)	1.15	**DFEE**	46.56	**TFEE**	53.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.37		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Semi-Detached House, total floor area 80 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.71 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.34 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 5.06 m², No overhang
Windows facing South: 0.72 m², No overhang
Windows facing West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	473.6848	562.7715	665.2376	775.8349	847.5725	837.1112	797.9449	733.9616	650.5315	542.9455	467.3250	445.2959	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9877	0.9778	0.9541	0.8957	0.7895	0.6359	0.4937	0.5472	0.7746	0.9354	0.9799	0.9899	(86)
MIT	19.0093	19.2546	19.6682	20.1953	20.6138	20.8705	20.9585	20.9413	20.7356	20.1622	19.4958	18.9778	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9850	0.9730	0.9439	0.8721	0.7416	0.5549	0.3854	0.4375	0.7060	0.9157	0.9748	0.9877	(89)
MIT 2	17.2373	17.5951	18.1928	18.9459	19.5056	19.8219	19.9045	19.8954	19.6790	18.9181	17.9589	17.1999	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6034	17.9379	18.4976	19.2040	19.7345	20.0385	20.1222	20.1114	19.8972	19.1751	18.2764	17.5671	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4534	17.7879	18.3476	19.0540	19.5845	19.8885	19.9722	19.9614	19.7472	19.0251	18.1264	17.4171	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9759	0.9597	0.9244	0.8491	0.7251	0.5518	0.3903	0.4411	0.6932	0.8942	0.9623	0.9799	(94)
Useful gains	462.2877	540.0770	614.9569	658.7438	614.5691	461.8970	311.4144	323.7163	450.9390	485.4776	449.6866	436.3361	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1305.5977	1274.5708	1167.4672	983.6096	761.3002	502.9427	320.6978	337.7344	540.2214	813.4986	1071.6426	1293.3035	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.4226	493.5799	411.0677	233.9034	109.1680	0.0000	0.0000	0.0000	0.0000	244.0476	447.8084	637.5837	(98)
Space heating												3204.5812	(98)
Space heating per m2											(98) / (4) =	40.1677	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3540.9737	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	627.4226	493.5799	411.0677	233.9034	109.1680	0.0000	0.0000	0.0000	0.0000	244.0476	447.8084	637.5837	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	693.2846	545.3921	454.2184	258.4568	120.6276	0.0000	0.0000	0.0000	0.0000	269.6659	494.8159	704.5124	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8140	89.7536	89.6201	89.3165	88.7442	87.3000	87.3000	87.3000	87.3000	89.3205	89.6820	89.8381	(217)
Fuel for water heating, kWh/month													
	183.8956	161.3765	167.8037	148.2581	144.2704	128.1956	120.4190	135.8687	136.8056	153.8712	165.3990	178.5283	(219)
Water heating fuel used												1824.6916	(219)
Annual totals kWh/year													
Space heating fuel - main system												3540.9737	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5797.5779	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3540.9737	0.2160	764.8503	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.6916	0.2160	394.1334	(264)
Space and water heating			1158.9837	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/year			1383.1464	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.3400	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		35.8363	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.8363	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	472.4332	548.6961	634.6280	726.4452	784.6852	772.1171	736.4376	682.6777	612.8588	523.6690	462.5036	446.4014	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9981	0.9957	0.9875	0.9564	0.8690	0.7017	0.5339	0.5929	0.8475	0.9776	0.9961	0.9986	(86)
MIT	19.7027	19.8613	20.1362	20.4976	20.7902	20.9494	20.9896	20.9828	20.8656	20.4708	20.0230	19.6801	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9975	0.9942	0.9830	0.9399	0.8215	0.6097	0.4144	0.4703	0.7753	0.9662	0.9945	0.9981	(89)
MIT 2	18.2035	18.4369	18.8381	19.3610	19.7477	19.9306	19.9602	19.9592	19.8512	19.3338	18.6834	18.1783	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5132	18.7311	19.1062	19.5958	19.9630	20.1411	20.1728	20.1706	20.0608	19.5687	18.9601	18.4885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9918	0.9781	0.9329	0.8221	0.6266	0.4392	0.4956	0.7835	0.9604	0.9922	0.9971	(94)
Useful gains	470.6160	544.1708	620.7324	677.7332	645.0818	483.7864	323.4325	338.3126	480.1711	502.9476	458.9157	445.0921	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1345.5016	1305.3554	1186.2018	992.2814	764.5404	506.3037	326.4608	343.7277	547.2975	829.8296	1103.3045	1336.6943	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating												3269.0044	(98)
Space heating per m2											(98) / (4) =	40.9752	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3500.0047	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	650.9148	511.5161	420.7093	226.4747	88.8773	0.0000	0.0000	0.0000	0.0000	243.2002	463.9599	663.3520	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	696.9110	547.6618	450.4382	242.4783	95.1577	0.0000	0.0000	0.0000	0.0000	260.3857	496.7451	710.2270	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7850	87.5653	87.0623	85.8702	83.6596	80.3000	80.3000	80.3000	80.3000	85.9298	87.2930	87.8671	(217)
Fuel for water heating, kWh/month													
	230.1120	202.4549	211.8581	190.5162	189.3271	173.7253	166.4421	185.5439	187.5930	199.6169	209.7595	224.4729	(219)
Water heating fuel used												2371.4221	(219)
Annual totals kWh/year													
Space heating fuel - main system												3500.0047	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												6303.3394	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3500.0047	0.2160	756.0010	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.4221	0.2160	512.2272	(264)
Space and water heating			1268.2282	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1492.3908	(272)
Emissions per m2 for space and water heating			15.8966	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8966 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.7100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3960	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3663	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4670	0.4578	0.4487	0.4029	0.3937	0.3480	0.3480	0.3388	0.3663	0.3937	0.4121	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4492	41.1610	40.8785	39.5518	39.3036	38.1481	38.1481	37.9341	38.5932	39.3036	39.8058	40.3307	(38)
Heat transfer coeff	97.3308	97.0426	96.7602	95.4335	95.1852	94.0297	94.0297	93.8157	94.4748	95.1852	95.6874	96.2124	(39)
Average = Sum(39)m / 12 =												95.4323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2200	1.2164	1.2128	1.1962	1.1931	1.1786	1.1786	1.1759	1.1842	1.1931	1.1994	1.2060	(40)
HLP (average)												1.1962	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	441.5784	531.4431	635.5241	748.3146	821.4770	813.0195	775.5536	709.3885	625.1809	515.3254	437.1418	413.9621	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3436	34.4456	34.5462	35.0264	35.1178	35.5493	35.5493	35.6304	35.3818	35.1178	34.9335	34.7429	
alpha	3.2896	3.2964	3.3031	3.3351	3.3412	3.3700	3.3700	3.3754	3.3588	3.3412	3.3289	3.3162	
util living area													
	0.9899	0.9810	0.9586	0.9023	0.7975	0.6448	0.5015	0.5581	0.7864	0.9425	0.9833	0.9919	(86)
MIT	18.9993	19.2455	19.6610	20.1875	20.6099	20.8680	20.9578	20.9393	20.7277	20.1450	19.4762	18.9624	(87)
Th 2	19.9040	19.9069	19.9097	19.9230	19.9255	19.9371	19.9371	19.9393	19.9327	19.9255	19.9205	19.9152	(88)
util rest of house													
	0.9877	0.9768	0.9494	0.8799	0.7508	0.5644	0.3930	0.4481	0.7198	0.9247	0.9790	0.9901	(89)
MIT 2	18.0813	18.3275	18.7388	19.2563	19.6438	19.8639	19.9218	19.9152	19.7609	19.2285	18.5683	18.0528	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2709	18.5171	18.9293	19.4487	19.8434	20.0713	20.1358	20.1268	19.9606	19.4178	18.7559	18.2407	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2709	18.5171	18.9293	19.4487	19.8434	20.0713	20.1358	20.1268	19.9606	19.4178	18.7559	18.2407	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9697	0.9387	0.8681	0.7468	0.5753	0.4142	0.4688	0.7218	0.9140	0.9726	0.9862	(94)
Useful gains	434.1460	515.3448	596.5714	649.6054	613.4907	467.7286	321.2535	332.5822	451.2293	471.0109	425.1732	408.2433	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1359.8031	1321.4424	1202.6597	1006.6946	775.1275	514.4690	332.4686	349.6304	553.6811	839.3232	1115.3188	1350.8858	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	688.6889	541.6975	450.9297	257.1042	120.2578	0.0000	0.0000	0.0000	0.0000	274.0244	496.9048	701.3259	(98)
Space heating												3530.9332	(98)
Space heating per m2											(98) / (4) =	44.2584	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	883.8794	695.8199	712.9996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8301	0.8864	0.8587	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	733.7453	616.7913	612.2297	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1042.2160	996.5510	920.8390	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	222.0989	282.5412	229.6053	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												734.2454	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.5247	70.6353	57.4013	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												183.5613	(107)
Space cooling per m2												2.3008	(108)
Energy for space heating												44.2584	(99)
Energy for space cooling												2.3008	(108)
Total												46.5592	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.6300	0.7000	0.7700	30.3717	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774	(80)

Solar gains	85.7365	164.4427	264.5287	378.7552	459.7283	469.0639	447.1766	386.7836	305.1163	193.3056	106.2703	70.9350	(83)
Total gains	427.9478	505.2996	593.4688	688.0993	748.3884	738.4467	704.4605	647.8968	576.6729	484.5933	420.2468	402.6847	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9988	0.9970	0.9906	0.9643	0.8855	0.7247	0.5557	0.6199	0.8706	0.9836	0.9975	0.9991	(86)
MIT	19.6511	19.8115	20.0908	20.4609	20.7676	20.9415	20.9876	20.9791	20.8452	20.4293	19.9743	19.6291	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9984	0.9960	0.9871	0.9503	0.8414	0.6329	0.4326	0.4940	0.8037	0.9749	0.9964	0.9988	(89)
MIT 2	18.7000	18.8623	19.1420	19.5138	19.7950	19.9372	19.9609	19.9602	19.8718	19.4906	19.0360	18.6870	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8965	19.0583	19.3380	19.7095	19.9959	20.1446	20.1729	20.1707	20.0729	19.6845	19.2298	18.8816	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9844	0.9463	0.8435	0.6502	0.4582	0.5202	0.8123	0.9719	0.9954	0.9984	(94)
Useful gains	427.0023	502.6483	584.2200	651.1352	631.2473	480.1137	322.8104	337.0254	468.4464	470.9619	418.2956	402.0272	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1381.7863	1336.2379	1208.0068	1002.8277	767.5815	506.6286	326.4703	343.7342	548.4112	840.5503	1128.3900	1373.4673	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	710.3593	560.1722	464.0973	253.2186	101.4326	0.0000	0.0000	0.0000	0.0000	274.9738	511.2679	722.7515	(98)
Space heating												3598.2733	(98)
Space heating per m2											(98) / (4) =	45.1024	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8754	0.9319	0.9069	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	751.9115	630.1425	628.3249	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	955.0530	913.4552	848.9656	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	146.2619	210.7847	164.1567	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												521.2033	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   36.5655   52.6962   41.0392    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        130.3008 (107)
Space cooling per m2                                                                                                   1.6333 (108)
Energy for space heating                                                                                              45.1024 (99)
Energy for space cooling                                                                                               1.6333 (108)
Total                                                                                                                 46.7357 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                53.7 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	112.4279	194.0642	308.1016	453.8349	536.0123	585.0267	551.7912	488.5037	384.9528	243.5239	142.7801	92.1059	(83)
Total gains	666.4204	743.6542	836.3110	948.9315	997.2353	1015.9149	964.9639	909.9575	825.4761	717.3716	653.6447	630.9479	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area	0.9631	0.9464	0.9038	0.8083	0.6561	0.4428	0.2984	0.3239	0.5936	0.8447	0.9398	0.9679	(86)
MIT	19.4987	19.6975	20.0771	20.5152	20.8228	20.9672	20.9938	20.9919	20.9077	20.5229	19.9597	19.4712	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house	0.9556	0.9356	0.8843	0.7710	0.5925	0.3561	0.1979	0.2192	0.5057	0.8047	0.9256	0.9613	(89)
MIT 2	17.9619	18.2492	18.7847	19.3834	19.7645	19.9197	19.9351	19.9392	19.8713	19.4143	18.6379	17.9304	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.2794	18.5484	19.0516	19.6172	19.9831	20.1360	20.1538	20.1567	20.0854	19.6433	18.9110	18.2487	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1294	18.3984	18.9016	19.4672	19.8331	19.9860	20.0038	20.0067	19.9354	19.4933	18.7610	18.0987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9156	0.8615	0.7525	0.5864	0.3601	0.2043	0.2258	0.5053	0.7849	0.9050	0.9454	(94)
Useful gains	625.3443	680.8910	720.5032	714.0985	584.7539	365.7809	197.1403	205.4629	417.1305	563.0319	591.5520	596.4850	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.0885	1224.3072	1100.2621	907.2685	647.9911	373.9881	197.8972	206.5252	444.2923	744.4443	1014.9014	1236.1838	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)

Space heating 2217.3511 (98)
RHI space heating demand 2217 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)

Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124 (83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9699	0.9540	0.9198	0.8460	0.7274	0.5687	0.4317	0.4755	0.6936	0.8843	0.9543	0.9740	(86)
MIT	19.2868	19.5156	19.8915	20.3560	20.7048	20.9077	20.9722	20.9615	20.8150	20.3467	19.7436	19.2536	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9638	0.9448	0.9038	0.8155	0.6749	0.4900	0.3335	0.3750	0.6193	0.8543	0.9437	0.9687	(89)
MIT 2	17.6371	17.9675	18.5038	19.1562	19.6101	19.8544	19.9122	19.9079	19.7596	19.1629	18.3111	17.5983	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	17.9779	18.2873	18.7905	19.4041	19.8362	20.0720	20.1312	20.1255	19.9776	19.4074	18.6070	17.9402	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8279	18.1373	18.6405	19.2541	19.6862	19.9220	19.9812	19.9755	19.8276	19.2574	18.4570	17.7902	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9254	0.8808	0.7940	0.6628	0.4897	0.3387	0.3795	0.6122	0.8318	0.9244	0.9543	(94)
Useful gains	619.3735	684.9717	735.3038	741.6538	658.8749	477.2300	315.4791	330.1048	486.1577	580.5113	586.1192	592.6631	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1342.7747	1309.1222	1196.3302	1002.9887	771.1227	506.1231	321.5518	339.0699	547.9092	835.9284	1103.7746	1329.8091	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)

Space heating 2683.4957 (98)

Space heating per m2 (98) / (4) = 33.6362 (99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2965.1886	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	594.7077	463.4576	379.0095	207.9129	92.2789	0.0000	0.0000	0.0000	0.0000	209.9783	411.8364	606.0073	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7277	89.6564	89.5001	89.1502	88.5359	87.3000	87.3000	87.3000	87.3000	89.1288	89.5654	89.7556	(217)
Fuel for water heating, kWh/month													
	184.0724	161.5514	168.0288	148.5347	144.6099	128.1956	120.4190	135.8687	136.8056	154.2020	165.6145	178.6925	(219)
Water heating fuel used												1826.5950	(219)
Annual totals kWh/year													
Space heating fuel - main system												2965.1886	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												5223.6962	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2965.1886	3.4800	103.1886	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.5950	3.4800	63.5655	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Total energy cost			343.7233	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1569	(257)
SAP value		83.8606	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2965.1886	0.2160	640.4807	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.5950	0.2160	394.5445	(264)
Space and water heating			1035.0252	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1259.1879	(272)
CO2 emissions per m2			15.7800	(273)
EI value			86.4777	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
											Solar input (sum of months) = Sum(63)m =	0.0000	(63)
Output from w/h													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
											Total per year (kWh/year) = Sum(64)m =	1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	112.4279	194.0642	308.1016	453.8349	536.0123	585.0267	551.7912	488.5037	384.9528	243.5239	142.7801	92.1059	(83)
Total gains	666.4204	743.6542	836.3110	948.9315	997.2353	1015.9149	964.9639	909.9575	825.4761	717.3716	653.6447	630.9479	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9631	0.9464	0.9038	0.8083	0.6561	0.4428	0.2984	0.3239	0.5936	0.8447	0.9398	0.9679	(86)
MIT	19.4987	19.6975	20.0771	20.5152	20.8228	20.9672	20.9938	20.9919	20.9077	20.5229	19.9597	19.4712	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9556	0.9356	0.8843	0.7710	0.5925	0.3561	0.1979	0.2192	0.5057	0.8047	0.9256	0.9613	(89)
MIT 2	17.9619	18.2492	18.7847	19.3834	19.7645	19.9197	19.9351	19.9392	19.8713	19.4143	18.6379	17.9304	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2794	18.5484	19.0516	19.6172	19.9831	20.1360	20.1538	20.1567	20.0854	19.6433	18.9110	18.2487	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1294	18.3984	18.9016	19.4672	19.8331	19.9860	20.0038	20.0067	19.9354	19.4933	18.7610	18.0987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9156	0.8615	0.7525	0.5864	0.3601	0.2043	0.2258	0.5053	0.7849	0.9050	0.9454	(94)
Useful gains	625.3443	680.8910	720.5032	714.0985	584.7539	365.7809	197.1403	205.4629	417.1305	563.0319	591.5520	596.4850	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1254.0885	1224.3072	1100.2621	907.2685	647.9911	373.9881	197.8972	206.5252	444.2923	744.4443	1014.9014	1236.1838	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating												2217.3511	(98)
Space heating per m2											(98) / (4) =	27.7933	(99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2450.1118	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	516.8902	403.5090	312.1996	153.6822	51.9873	0.0000	0.0000	0.0000	0.0000	149.1390	336.8084	525.8961	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6426	89.5676	89.3622	88.9105	88.1375	87.3000	87.3000	87.3000	87.3000	88.8567	89.4270	89.6715	(217)
Fuel for water heating, kWh/month													
	184.2472	161.7116	168.2881	148.9352	145.2635	128.1956	120.4190	135.8687	136.8056	154.6742	165.8707	178.8600	(219)
Water heating fuel used												1829.1394	(219)
Annual totals kWh/year													
Space heating fuel - main system												2450.1118	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Total delivered energy for all uses												4711.1638	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2450.1118	3.9200	96.0444	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1829.1394	3.9200	71.7023	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Total energy cost			328.9990	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2450.1118	0.2160	529.2241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.1394	0.2160	395.0941	(264)
Space and water heating			924.3182	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total kg/year			1148.4809	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2450.1118	1.2200	2989.1364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1829.1394	1.2200	2231.5500	(264)
Space and water heating			5220.6864	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Primary energy kWh/year			6546.6582	(272)
Primary energy kWh/m2/year			82.0589	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):		
A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-181 kg (15.8%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (97.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£29	2.27 kg/m²	B 85	B 88
Solar photovoltaic panels	£309	11.87 kg/m²	A 96	A 98
Total Savings	£339	14.14 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£73	£82	-£8
Mains gas	£256	£218	£38
Space heating	£197	£197	£0
Water heating	£72	£43	£29
Lighting	£61	£61	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£329	-£9	£339
Total cost of uses	£330	-£8	£338
Delivered energy	59 kWh/m²	25 kWh/m²	34 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	0 kg/m²	14 kg/m²
Primary energy	82 kWh/m²	-1 kWh/m²	83 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4445	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5242	0.5139	0.5036	0.4522	0.4420	0.3906	0.3906	0.3803	0.4111	0.4420	0.4625	0.4831	(22b)
Effective ac	0.6374	0.6320	0.6268	0.6023	0.5977	0.5763	0.5763	0.5723	0.5845	0.5977	0.6070	0.6167	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.3780	43.0149	42.6590	40.9875	40.6747	39.2189	39.2189	38.9493	39.7797	40.6747	41.3074	41.9688	(38)
Heat transfer coeff	99.2596	98.8965	98.5406	96.8691	96.5564	95.1005	95.1005	94.8309	95.6613	96.5564	97.1890	97.8505	(39)
Average = Sum(39)m / 12 =												96.8676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2442	1.2396	1.2352	1.2142	1.2103	1.1920	1.1920	1.1887	1.1991	1.2103	1.2182	1.2265	(40)
HLP (average)												1.2142	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	19.6403	0.4600	0.0000	0.7700	35.2003	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
West	3.0000	19.6403	0.4600	0.0000	0.7700	20.8697	(80)
West	4.5100	19.6403	0.4600	0.0000	0.7700	31.3742	(80)

Solar gains	99.3671	190.5861	306.5840	438.9705	532.8169	543.6367	518.2697	448.2753	353.6243	224.0378	123.1654	82.2124	(83)
Total gains	653.3596	740.1760	834.7935	934.0670	994.0398	974.5249	931.4423	869.7292	794.1476	697.8855	634.0299	621.0544	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6763	33.7999	33.9220	34.5073	34.6191	35.1491	35.1491	35.2490	34.9430	34.6191	34.3937	34.1612	
alpha	3.2451	3.2533	3.2615	3.3005	3.3079	3.3433	3.3433	3.3499	3.3295	3.3079	3.2929	3.2774	
util living area													
	0.9699	0.9540	0.9198	0.8460	0.7274	0.5687	0.4317	0.4755	0.6936	0.8843	0.9543	0.9740	(86)
MIT	19.2868	19.5156	19.8915	20.3560	20.7048	20.9077	20.9722	20.9615	20.8150	20.3467	19.7436	19.2536	(87)
Th 2	19.8848	19.8884	19.8920	19.9087	19.9118	19.9264	19.9264	19.9291	19.9207	19.9118	19.9055	19.8989	(88)
util rest of house													
	0.9638	0.9448	0.9038	0.8155	0.6749	0.4900	0.3335	0.3750	0.6193	0.8543	0.9437	0.9687	(89)
MIT 2	17.6371	17.9675	18.5038	19.1562	19.6101	19.8544	19.9122	19.9079	19.7596	19.1629	18.3111	17.5983	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	17.9779	18.2873	18.7905	19.4041	19.8362	20.0720	20.1312	20.1255	19.9776	19.4074	18.6070	17.9402	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8279	18.1373	18.6405	19.2541	19.6862	19.9220	19.9812	19.9755	19.8276	19.2574	18.4570	17.7902	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9254	0.8808	0.7940	0.6628	0.4897	0.3387	0.3795	0.6122	0.8318	0.9244	0.9543	(94)
Useful gains	619.3735	684.9717	735.3038	741.6538	658.8749	477.2300	315.4791	330.1048	486.1577	580.5113	586.1192	592.6631	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1342.7747	1309.1222	1196.3302	1002.9887	771.1227	506.1231	321.5518	339.0699	547.9092	835.9284	1103.7746	1329.8091	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)
Space heating												2683.4957	(98)
Space heating per m2											(98) / (4) =	33.6362	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2965.1886	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	538.2105	419.4292	343.0036	188.1611	83.5124	0.0000	0.0000	0.0000	0.0000	190.0303	372.7119	548.4366	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	594.7077	463.4576	379.0095	207.9129	92.2789	0.0000	0.0000	0.0000	0.0000	209.9783	411.8364	606.0073	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8177	89.8455	89.8714	89.9309	90.0568	87.3000	87.3000	87.3000	87.3000	89.4841	89.7026	89.8307	(217)
Fuel for water heating, kWh/month	156.6586	115.7875	89.9946	43.6632	14.3797	0.0000	0.0000	24.1300	49.2919	95.2868	133.0217	155.7601	(219)
Water heating fuel used												877.9742	(219)
Annual totals kWh/year													
Space heating fuel - main system												2965.1886	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2597.8360	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2965.1886	3.4800	103.1886	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9742	3.4800	30.5535	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			89.4835	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.3012	(257)
SAP value	95.7983	
SAP rating (Section 12)	96	(258)
SAP band	A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2965.1886	0.2160	640.4807	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9742	0.2160	189.6424	(264)
Space and water heating			830.1232	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			183.7986	(272)
CO2 emissions per m2			2.3000	(273)
EI value			98.0262	
EI rating			98	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4445	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4111	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4317	0.4111	0.4111	0.3803	0.3803	0.3392	0.3495	0.3289	0.3392	0.3597	0.3597	0.3906	(22b)
Effective ac	0.5932	0.5845	0.5845	0.5723	0.5723	0.5575	0.5611	0.5541	0.5575	0.5647	0.5647	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3692	39.7797	39.7797	38.9493	38.9493	37.9428	38.1836	37.7091	37.9428	38.4317	38.4317	39.2189	(38)
Heat transfer coeff	96.2508	95.6613	95.6613	94.8309	94.8309	93.8244	94.0653	93.5908	93.8244	94.3133	94.3133	95.1005	(39)
Average = Sum(39)m / 12 =												94.6889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.1991	1.1991	1.1887	1.1887	1.1760	1.1791	1.1731	1.1760	1.1822	1.1822	1.1920	(40)
HLP (average)												1.1869	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3147	(H8)
Utilisation factor												0.5326	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-859.2180	(H17)
Solar input	-26.4463	-39.7487	-66.9419	-92.5342	-111.4423	-117.2882	-114.4719	-102.2241	-79.7862	-54.2771	-32.1462	-21.9109	(63)
											Solar input (sum of months) = Sum(63)m =	-859.2180	(63)
Output from w/h													
	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
											Total per year (kWh/year) = Sum(64)m =	777.5864	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0600	22.3313	0.4600	0.0000	0.7700	40.0233	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
West	3.0000	22.3313	0.4600	0.0000	0.7700	23.7293	(80)
West	4.5100	22.3313	0.4600	0.0000	0.7700	35.6730	(80)

Solar gains	112.4279	194.0642	308.1016	453.8349	536.0123	585.0267	551.7912	488.5037	384.9528	243.5239	142.7801	92.1059	(83)
Total gains	666.4204	743.6542	836.3110	948.9315	997.2353	1015.9149	964.9639	909.9575	825.4761	717.3716	653.6447	630.9479	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7290	34.9430	34.9430	35.2490	35.2490	35.6271	35.5359	35.7161	35.6271	35.4424	35.4424	35.1491	
alpha	3.3153	3.3295	3.3295	3.3499	3.3499	3.3751	3.3691	3.3811	3.3751	3.3628	3.3628	3.3433	
util living area													
	0.9631	0.9464	0.9038	0.8083	0.6561	0.4428	0.2984	0.3239	0.5936	0.8447	0.9398	0.9679	(86)
MIT	19.4987	19.6975	20.0771	20.5152	20.8228	20.9672	20.9938	20.9919	20.9077	20.5229	19.9597	19.4712	(87)
Th 2	19.9148	19.9207	19.9207	19.9291	19.9291	19.9392	19.9368	19.9416	19.9392	19.9343	19.9343	19.9264	(88)
util rest of house													
	0.9556	0.9356	0.8843	0.7710	0.5925	0.3561	0.1979	0.2192	0.5057	0.8047	0.9256	0.9613	(89)
MIT 2	17.9619	18.2492	18.7847	19.3834	19.7645	19.9197	19.9351	19.9392	19.8713	19.4143	18.6379	17.9304	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.2794	18.5484	19.0516	19.6172	19.9831	20.1360	20.1538	20.1567	20.0854	19.6433	18.9110	18.2487	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1294	18.3984	18.9016	19.4672	19.8331	19.9860	20.0038	20.0067	19.9354	19.4933	18.7610	18.0987	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9384	0.9156	0.8615	0.7525	0.5864	0.3601	0.2043	0.2258	0.5053	0.7849	0.9050	0.9454	(94)
Useful gains	625.3443	680.8910	720.5032	714.0985	584.7539	365.7809	197.1403	205.4629	417.1305	563.0319	591.5520	596.4850	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1254.0885	1224.3072	1100.2621	907.2685	647.9911	373.9881	197.8972	206.5252	444.2923	744.4443	1014.9014	1236.1838	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating												2217.3511	(98)
Space heating per m2											(98) / (4) =	27.7933	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2450.1118	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	467.7857	365.1756	282.5406	139.0824	47.0485	0.0000	0.0000	0.0000	0.0000	134.9708	304.8116	475.9359	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	516.8902	403.5090	312.1996	153.6822	51.9873	0.0000	0.0000	0.0000	0.0000	149.1390	336.8084	525.8961	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	138.7176	105.0925	83.4439	39.8847	16.5893	0.0000	0.0000	16.3893	39.6451	83.1613	116.1870	138.4756	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7476	89.7647	89.7499	89.7667	89.6434	87.3000	87.3000	87.3000	87.3000	89.2527	89.5937	89.7585	(217)
Fuel for water heating, kWh/month	154.5642	117.0755	92.9738	44.4316	18.5059	0.0000	0.0000	18.7735	45.4125	93.1751	129.6822	154.2757	(219)
Water heating fuel used												868.8700	(219)

Annual totals kWh/year		
Space heating fuel - main system	2450.1118	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	(233)
Total delivered energy for all uses	1976.7348	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2450.1118	3.9200	96.0444	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	868.8700	3.9200	34.0597	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	356.9126	16.9600	60.5324	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-9.5410	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2450.1118	0.2160	529.2241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8700	0.2160	187.6759	(264)
Space and water heating			716.9001	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			20.2739	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2450.1118	1.2200	2989.1364	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	868.8700	1.2200	1060.0214	(264)
Space and water heating			4049.1578	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-71.5405	(272)
Primary energy kWh/m2/year			-0.8967	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	5.0600	117.5071	0.4600	0.0000	0.9000	246.1585
South	0.7200	112.2060	0.4600	0.0000	0.9000	33.4464
West	3.0000	117.5071	0.4600	0.0000	0.9000	145.9438
West	4.5100	117.5071	0.4600	0.0000	0.9000	219.4021
total:						644.9508

	Jun	Jul	Aug	
Solar gains	684	645	571	(P4)
Internal gains	428	410	418	
Total summer gains	1112	1055	989	(P5)
Summer gain/loss ratio	3.39	3.22	3.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	20.33	22.06	21.76	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-353	**Issued on Date**	19/10/2022
Assessment Reference	Plot 353	**Prop Type Ref**	Dawlish-As-DET
Property	Plot 353, 3 Bed, K, WC, Ut, B, En		

SAP Rating	83 B	**DER**	18.18	**TER**	19.04
Environmental	85 B	**% DER<TER**	4.53		
CO_2 Emissions (t/year)	1.46	**DFEE**	53.62	**TFEE**	61.24
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.44		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Detached House, total floor area 97 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.04 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.18 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)61.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 6.28 m², No overhang
Windows facing East: 7.74 m², No overhang
Windows facing South: 5.95 m², No overhang
Windows facing West: 1.31 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5732	0.5620	0.5507	0.4945	0.4833	0.4271	0.4271	0.4159	0.4496	0.4833	0.5058	0.5283	(22b)
Effective ac	0.6643	0.6579	0.6517	0.6223	0.6168	0.5912	0.5912	0.5865	0.6011	0.6168	0.6279	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	84.7268 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0546	54.5259	54.0076	51.5733	51.1179	48.9977	48.9977	48.6051	49.8144	51.1179	52.0393	53.0025	(38)
Heat transfer coeff	139.7814	139.2527	138.7344	136.3002	135.8447	133.7245	133.7245	133.3319	134.5412	135.8447	136.7661	137.7293	(39)
Average = Sum(39)m / 12 =												136.2980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4357	1.4303	1.4250	1.4000	1.3953	1.3735	1.3735	1.3695	1.3819	1.3953	1.4047	1.4146	(40)
HLP (average)												1.3999	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Daily hot water use
            108.5156  104.5695  100.6235   96.6775   92.7315   88.7855   88.7855   92.7315   96.6775  100.6235  104.5695  108.5156 (44)
Energy conte  160.9254  140.7464  145.2377  126.6217  121.4966  104.8423   97.1518  111.4831  112.8146  131.4745  143.5147  155.8477 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.1388   21.1120   21.7857   18.9933   18.2245   15.7263   14.5728   16.7225   16.9222   19.7212   21.5272   23.3772 (46)
Water storage loss:
Total storage loss
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Combi loss    14.1428   12.7631   14.1051   13.6066   14.0270   13.5362   13.9636   14.0047   13.5746   14.0721   13.6572   14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
              57.0434   49.9890   51.8178   45.5034   43.9044   38.2441   35.7939   40.5693   40.9045   47.2333   51.1330   55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853  135.6853 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              22.4777   19.9645   16.2362   12.2919    9.1883    7.7572    8.3819   10.8951   14.6234   18.5677   21.6713   23.1024 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             251.9878  254.6027  248.0133  233.9854  216.2777  199.6350  188.5166  185.9018  192.4911  206.5190  224.2267  240.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685   36.5685 (69)
Pumps, fans    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 (71)
Water heating gains (Table 5)
              76.6712   74.3883   69.6476   63.1991   59.0112   53.1168   48.1100   54.5286   56.8118   63.4856   71.0180   74.3979 (72)
Total internal gains
             417.8424  415.6611  400.6028  376.1820  351.1829  327.2146  311.7142  318.0311  330.6319  355.2780  383.6216  405.0753 (73)
```

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	10.6334	0.4600	0.0000	0.7700	23.6527	(74)
East	7.7400	19.6403	0.4600	0.0000	0.7700	53.8439	(76)
South	2.6200	46.7521	0.4600	0.0000	0.7700	43.3861	(78)
West	1.3100	19.6403	0.4600	0.0000	0.7700	9.1131	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

```
Solar gains  185.1392  329.7248  485.1825  651.4965  770.8053  781.9995  747.0485  656.3347  542.9625  373.9913  224.4697  156.6294 (83)
Total gains  602.9816  745.3858  885.7853 1027.6785 1121.9882 1109.2141 1058.7627  974.3658  873.5944  729.2693  608.0913  561.7048 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          34.6996   34.8314   34.9615   35.5859   35.7052   36.2713   36.2713   36.3781   36.0512   35.7052   35.4647   35.2167
alpha         3.3133    3.3221    3.3308    3.3724    3.3803    3.4181    3.4181    3.4252    3.4034    3.3803    3.3643    3.3478
util living area
               0.9916    0.9826    0.9625    0.9125    0.8152    0.6651    0.5199    0.5746    0.7958    0.9452    0.9852    0.9934 (86)

MIT           18.9786   19.2406   19.6475   20.1652   20.5904   20.8606   20.9552   20.9369   20.7254   20.1503   19.4740   18.9464 (87)
Th 2          19.7361   19.7402   19.7442   19.7634   19.7670   19.7837   19.7837   19.7868   19.7772   19.7670   19.7597   19.7521 (88)
util rest of house
               0.9894    0.9781    0.9524    0.8880    0.7625    0.5712    0.3912    0.4450    0.7185    0.9249    0.9806    0.9916 (89)
MIT 2         17.0744   17.4571   18.0457   18.7871   19.3536   19.6807   19.7638   19.7557   19.5423   18.7850   17.8110   17.0371 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.2028 (91)
MIT           17.4605   17.8187   18.3705   19.0665   19.6043   19.9199   20.0054   19.9952   19.7822   19.0618   18.1482   17.4242 (92)
Temperature adjustment                                                                                                    -0.1500
adjusted MIT  17.3105   17.6687   18.2205   18.9165   19.4543   19.7699   19.8554   19.8452   19.6322   18.9118   17.9982   17.2742 (93)
```

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8. Space heating requirement

```
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation   0.9826    0.9669    0.9351    0.8666    0.7468    0.5700    0.3993    0.4518    0.7075    0.9052    0.9704    0.9860 (94)
Useful gains 592.4966  720.7062  828.3232  890.5799  837.8799  632.2776  422.7879  440.1864  618.0971  660.1632  590.0971  553.8319 (95)
Ext temp.     4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            1818.6199 1778.0749 1626.0378 1365.2553 1053.3839  691.3425  435.3226  459.3518  744.3089 1129.1171 1490.5015 1800.7036 (97)
Month fracti  1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             912.2358  710.5517  593.4996  341.7663  160.3349    0.0000    0.0000    0.0000    0.0000  348.9017  648.2912  927.6726 (98)
Space heating                                                                                                            4643.2538 (98)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 47.6916 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5130.6672	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	912.2358	710.5517	593.4996	341.7663	160.3349	0.0000	0.0000	0.0000	0.0000	348.9017	648.2912	927.6726	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1007.9954	785.1400	655.8007	377.6423	177.1657	0.0000	0.0000	0.0000	0.0000	385.5267	716.3439	1025.0526	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9690	89.9145	89.8033	89.5451	89.0055	87.3000	87.3000	87.3000	87.3000	89.5339	89.8573	89.9892	(217)
Fuel for water heating, kWh/month													
	194.5872	170.7284	177.4354	156.6008	152.2642	135.5997	127.2799	143.7432	144.7757	162.5603	174.9129	188.8874	(219)
Water heating fuel used												1929.3751	(219)
Annual totals kWh/year													
Space heating fuel - main system												5130.6672	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Total delivered energy for all uses												7532.0058	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5130.6672	0.2160	1108.2241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.3751	0.2160	416.7450	(264)
Space and water heating			1524.9691	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Total CO2, kg/year			1769.9182	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.1800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.1800	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		35.4084	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.4084	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 50.9589 46.0274 50.9589 47.6766 47.2549 43.7846 45.2441 47.2549 47.6766 50.9589 49.3151 50.9589 (61)
Total heat required for water heating calculated for each month
211.8843 186.7738 196.1966 174.2983 168.7515 148.6269 142.3959 158.7381 160.4912 182.4334 192.8298 206.8066 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
211.8843 186.7738 196.1966 174.2983 168.7515 148.6269 142.3959 158.7381 160.4912 182.4334 192.8298 206.8066 (64)
Total per year (kWh/year) = Sum(64)m = 2130.2265 (64)
Heat gains from water heating, kWh/month
66.2474 58.3050 61.0313 54.0209 52.2113 45.8062 43.6140 48.8819 49.4300 56.4550 60.0474 64.5591 (65)

---

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	89.0423	86.7634	82.0313	75.0290	70.1765	63.6197	58.6210	65.7014	68.6528	75.8804	83.3992	86.7730	(72)
Total internal gains													
	430.2925	428.1065	413.0436	388.0552	362.3805	337.7448	322.2546	329.2423	342.5243	367.7381	396.0791	417.5318	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9200	10.6334	0.6300	0.7000	0.7700	19.2382	(74)
East	7.3100	19.6403	0.6300	0.7000	0.7700	43.8770	(76)
South	5.6200	46.7521	0.6300	0.7000	0.7700	80.2988	(78)
West	1.2400	19.6403	0.6300	0.7000	0.7700	7.4429	(80)

Solar gains	150.8569	268.6665	395.3241	530.8075	627.9843	637.0900	608.6217	534.7384	442.3942	304.7329	182.9041	127.6264	(83)
Total gains	581.1494	696.7729	808.3676	918.8627	990.3649	974.8348	930.8763	863.9807	784.9186	672.4710	578.9831	545.1582	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9980	0.9951	0.9867	0.9588	0.8831	0.7326	0.5687	0.6270	0.8593	0.9766	0.9958	0.9985	(86)
MIT	19.5255	19.7084	20.0028	20.3862	20.7161	20.9185	20.9801	20.9693	20.8188	20.3808	19.8827	19.4981	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9973	0.9933	0.9818	0.9425	0.8360	0.6340	0.4317	0.4889	0.7853	0.9643	0.9940	0.9980	(89)
MIT 2	17.8681	18.1369	18.5662	19.1213	19.5626	19.7984	19.8454	19.8422	19.7020	19.1243	18.4014	17.8356	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.2041	18.4555	18.8574	19.3778	19.7965	20.0255	20.0754	20.0707	19.9285	19.3791	18.7017	18.1727	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2041	18.4555	18.8574	19.3778	19.7965	20.0255	20.0754	20.0707	19.9285	19.3791	18.7017	18.1727	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9903	0.9760	0.9340	0.8339	0.6503	0.4596	0.5167	0.7915	0.9574	0.9913	0.9968	(94)
Useful gains	578.6637	690.0195	788.9812	858.2502	825.8381	633.9755	427.7902	446.4147	621.2721	643.8461	573.9417	543.3951	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1796.6422	1746.7505	1588.0461	1329.2690	1024.6760	678.8723	434.8679	458.3319	732.5060	1111.0611	1475.5081	1786.1340	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	906.1760	710.1232	594.5042	339.1335	147.9354	0.0000	0.0000	0.0000	0.0000	347.6079	649.1278	924.5978	(98)
Space heating												4619.2059	(98)
Space heating per m2											(98) / (4) =	47.4446	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4945.6166	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	906.1760	710.1232	594.5042	339.1335	147.9354	0.0000	0.0000	0.0000	0.0000	347.6079	649.1278	924.5978	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	970.2098	760.3032	636.5142	363.0980	158.3891	0.0000	0.0000	0.0000	0.0000	372.1712	694.9976	989.9334	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2954	88.0926	87.6641	86.6981	84.7217	80.3000	80.3000	80.3000	80.3000	86.6489	87.8688	88.3683	(217)
Fuel for water heating, kWh/month													
	239.9722	212.0198	223.8051	201.0405	199.1833	185.0896	177.3299	197.6813	199.8645	210.5434	219.4519	234.0279	(219)
Water heating fuel used												2500.0094	(219)
Annual totals kWh/year													
Space heating fuel - main system												4945.6166	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												7918.9870	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4945.6166	0.2160	1068.2532	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2500.0094	0.2160	540.0020	(264)
Space and water heating			1608.2552	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1853.9296	(272)
Emissions per m2 for space and water heating			16.5186	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5186 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			19.0400	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3700	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4717	0.4624	0.4532	0.4069	0.3977	0.3515	0.3515	0.3422	0.3700	0.3977	0.4162	0.4347	(22b)
Effective ac	0.6112	0.6069	0.6027	0.5828	0.5791	0.5618	0.5618	0.5586	0.5684	0.5791	0.5866	0.5945	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6581	50.3001	49.9492	48.3009	47.9925	46.5569	46.5569	46.2911	47.1099	47.9925	48.6164	49.2686	(38)
Heat transfer coeff	135.3849	135.0269	134.6760	133.0277	132.7193	131.2837	131.2837	131.0179	131.8367	132.7193	133.3432	133.9954	(39)
Average = Sum(39)m / 12 =												133.0262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3906	1.3869	1.3833	1.3663	1.3632	1.3484	1.3484	1.3457	1.3541	1.3632	1.3696	1.3763	(40)
HLP (average)												1.3663	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Heat gains from water heating, kWh/month
               34.1967    29.9086    30.8630    26.9071    25.8180    22.2790    20.6448    23.6902    23.9731    27.9383    30.4969    33.1176 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853   135.6853 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                22.4777    19.9645    16.2362    12.2919     9.1883     7.7572     8.3819    10.8951    14.6234    18.5677    21.6713    23.1024 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               251.9878   254.6027   248.0133   233.9854   216.2777   199.6350   188.5166   185.9018   192.4911   206.5190   224.2267   240.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685    36.5685 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
                45.9632    44.5069    41.4825    37.3710    34.7016    30.9430    27.7483    31.8416    33.2960    37.5515    42.3568    44.5130 (72)
Total internal gains
               384.1344   382.7796   369.4377   347.3539   323.8733   302.0408   288.3524   292.3441   304.1161   326.3439   351.9604   372.1904 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access              Gains
                                         m2              Table 6a      Specific data    Specific data       factor                W
                                                           W/m2        or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
North                                  6.2800            10.6334            0.4600           0.0000           0.7700            23.6527 (74)
East                                   7.7400            19.6403            0.4600           0.0000           0.7700            53.8439 (76)
South                                  2.6200            46.7521            0.4600           0.0000           0.7700            43.3861 (78)
West                                   1.3100            19.6403            0.4600           0.0000           0.7700             9.1131 (80)
South                                  3.3300            46.7521            0.4600           0.0000           0.7700            55.1434 (78)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains    569.2736   712.5044   854.6202   998.8504  1094.6786  1084.0403  1035.4010   948.6788   847.0786   700.3352   576.4301   528.8198 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            35.8265    35.9215    36.0151    36.4613    36.5460    36.9457    36.9457    37.0206    36.7907    36.5460    36.3751    36.1980
alpha           3.3884     3.3948     3.4010     3.4308     3.4364     3.4630     3.4630     3.4680     3.4527     3.4364     3.4250     3.4132
util living area
                0.9930     0.9846     0.9652     0.9160     0.8186     0.6689     0.5226     0.5800     0.8022     0.9497     0.9873     0.9945 (86)

MIT            19.0063    19.2674    19.6717    20.1788    20.6000    20.8634    20.9566    20.9377    20.7272    20.1539    19.4828    18.9651 (87)
Th 2           19.7706    19.7734    19.7762    19.7892    19.7917    19.8031    19.8031    19.8052    19.7987    19.7917    19.7867    19.7816 (88)
util rest of house
                0.9912     0.9807     0.9559     0.8926     0.7671     0.5762     0.3953     0.4514     0.7268     0.9309     0.9834     0.9931 (89)
MIT 2          17.9713    18.2323    18.6326    19.1308    19.5147    19.7337    19.7898    19.7840    19.6379    19.1197    18.4579    17.9383 (90)
Living area fraction                                                                                    fLA = Living area / (4) =       0.2028 (91)
MIT            18.1812    18.4422    18.8432    19.3433    19.7347    19.9627    20.0263    20.0179    19.8588    19.3294    18.6657    18.1465 (92)
Temperature adjustment                                                                                                              0.0000
adjusted MIT   18.1812    18.4422    18.8432    19.3433    19.7347    19.9627    20.0263    20.0179    19.8588    19.3294    18.6657    18.1465 (93)
```

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8. Space heating requirement

```
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9878     0.9747     0.9466     0.8820     0.7643     0.5897     0.4204     0.4760     0.7312     0.9214     0.9782     0.9903 (94)
Useful gains  562.3007   694.4838   808.9656   881.0310   836.7018   639.2380   435.2923   451.6182   619.3997   645.3225   563.8623   523.7005 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1879.3002  1828.5612  1662.3389  1389.2422  1066.3609   704.0372   449.8239   474.0073   759.2182  1158.5627  1542.2118  1868.7671 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              979.8477   762.1000   634.9097   365.9120   170.8664     0.0000     0.0000     0.0000     0.0000   381.8507   704.4116  1000.7296 (98)
Space heating                                                                                                                      5000.6278 (98)
Space heating per m2                                                                                                  (98) / (4) =    51.3622 (99)
```

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1234.0670	971.4996	995.7358	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8148	0.8757	0.8456	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1005.4862	850.7792	841.9645	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1370.5941	1311.5148	1211.9592	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	262.8776	342.7873	275.2761	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												880.9410	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	65.7194	85.6968	68.8190	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												220.2352	(107)
Space cooling per m2												2.2621	(108)
Energy for space heating												51.3622	(99)
Energy for space cooling												2.2621	(108)
Total												53.6243	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	73.0200	15.5300	57.4900	0.1800	10.3482			(29a)
EW WBoard ACC015	74.0200	8.8200	65.2000	0.1800	11.7360			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

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Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9200	10.6334	0.6300	0.7000	0.7700	19.2382	(74)
East	7.3100	19.6403	0.6300	0.7000	0.7700	43.8770	(76)
South	5.6200	46.7521	0.6300	0.7000	0.7700	80.2988	(78)
West	1.2400	19.6403	0.6300	0.7000	0.7700	7.4429	(80)

Solar gains	150.8569	268.6665	395.3241	530.8075	627.9843	637.0900	608.6217	534.7384	442.3942	304.7329	182.9041	127.6264	(83)
Total gains	535.0704	651.5164	764.8189	878.2047	951.8900	939.1581	897.0036	827.1209	746.5618	631.1421	534.9407	499.8982	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9986	0.9962	0.9893	0.9648	0.8952	0.7505	0.5870	0.6490	0.8765	0.9815	0.9969	0.9990	(86)
MIT	19.4828	19.6670	19.9644	20.3545	20.6949	20.9097	20.9774	20.9647	20.7999	20.3458	19.8421	19.4560	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9980	0.9949	0.9852	0.9504	0.8511	0.6528	0.4471	0.5088	0.8072	0.9715	0.9956	0.9986	(89)
MIT 2	18.4447	18.6305	18.9280	19.3194	19.6342	19.8109	19.8469	19.8447	19.7354	19.3185	18.8162	18.4265	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6551	18.8407	19.1382	19.5293	19.8492	20.0337	20.0761	20.0717	19.9512	19.5268	19.0242	18.6352	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6551	18.8407	19.1382	19.5293	19.8492	20.0337	20.0761	20.0717	19.9512	19.5268	19.0242	18.6352	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9933	0.9820	0.9455	0.8514	0.6699	0.4758	0.5374	0.8147	0.9677	0.9943	0.9980	(94)
Useful gains	533.6322	647.1642	751.0215	830.3150	810.4733	629.1508	426.7987	444.4907	608.2526	610.7774	531.8906	498.9099	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1854.9178	1796.3830	1624.1201	1348.4847	1031.3508	679.8953	434.9490	458.4584	735.3662	1129.7521	1516.5262	1845.2625	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	983.0365	772.2751	649.5853	373.0822	164.3328	0.0000	0.0000	0.0000	0.0000	386.1172	708.9376	1001.6863	(98)
Space heating												5039.0531	(98)
Space heating per m2											(98) / (4) =	51.7569	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8301	0.8977	0.8673	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	976.3096	831.2324	822.9787	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1201.2876	1149.7910	1069.9296	0.0000	0.0000	0.0000	0.0000	(103)

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Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	161.9842	237.0076	183.7315	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												582.7233 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	40.4961	59.2519	45.9329	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												145.6808 (107)
Space cooling per m2												1.4963 (108)
Energy for space heating												51.7569 (99)
Energy for space cooling												1.4963 (108)
Total												53.2532 (109)
Target Fabric Energy Efficiency (TFEE)												61.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4721	0.4496	0.4496	0.4159	0.4159	0.3709	0.3822	0.3597	0.3709	0.3934	0.3934	0.4271	(22b)
Effective ac	0.6114	0.6011	0.6011	0.5865	0.5865	0.5688	0.5730	0.5647	0.5688	0.5774	0.5774	0.5912	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6729	49.8144	49.8144	48.6051	48.6051	47.1393	47.4900	46.7990	47.1393	47.8513	47.8513	48.9977	(38)
Heat transfer coeff	135.3997	134.5412	134.5412	133.3319	133.3319	131.8661	132.2169	131.5258	131.8661	132.5781	132.5781	133.7245	(39)
Average = Sum(39)m / 12 =												133.1251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3907	1.3819	1.3819	1.3695	1.3695	1.3544	1.3580	1.3509	1.3544	1.3617	1.3617	1.3735	(40)
HLP (average)												1.3673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156 (44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477 (45)
Energy content (annual)										Total = Sum(45)m =		1552.1566 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306 (61)

Total heat required for water heating calculated for each month

	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (64)
								Total per year (kWh/year) = Sum(64)m =				1717.7401 (64)

RHI water heating demand 1718 (64)

Heat gains from water heating, kWh/month

	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482 (71)

Water heating gains (Table 5)

	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979 (72)

Total internal gains

	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307 (73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	11.9814	0.4600	0.0000	0.7700	26.6512	(74)
East	7.7400	22.3313	0.4600	0.0000	0.7700	61.2215	(76)
South	2.6200	50.9848	0.4600	0.0000	0.7700	47.3141	(78)
West	1.3100	22.3313	0.4600	0.0000	0.7700	10.3618	(80)
South	3.3300	50.9848	0.4600	0.0000	0.7700	60.1359	(78)

Solar gains	205.6845	330.1265	481.3461	668.7839	773.1314	840.3401	793.7295	711.5244	584.8199	400.2111	255.5800	172.2747	(83)
Total gains	825.9213	945.7001	1073.0235	1223.2148	1289.1861	1322.0826	1255.4324	1182.0262	1076.7603	929.6235	826.7130	775.2053	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8226	36.0512	36.0512	36.3781	36.3781	36.7825	36.6849	36.8777	36.7825	36.5850	36.5850	36.2713	
alpha	3.3882	3.4034	3.4034	3.4252	3.4252	3.4522	3.4457	3.4585	3.4522	3.4390	3.4390	3.4181	
util living area													
	0.9756	0.9611	0.9257	0.8414	0.6959	0.4750	0.3218	0.3496	0.6295	0.8726	0.9567	0.9796	(86)
MIT	19.4162	19.6299	20.0145	20.4675	20.7998	20.9628	20.9930	20.9909	20.8969	20.4852	19.8964	19.3867	(87)
Th 2	19.7705	19.7772	19.7772	19.7868	19.7868	19.7985	19.7957	19.8012	19.7985	19.7928	19.7928	19.7837	(88)
util rest of house													
	0.9695	0.9515	0.9069	0.8021	0.6232	0.3705	0.1990	0.2217	0.5264	0.8308	0.9440	0.9743	(89)
MIT 2	17.7287	18.0387	18.5830	19.2035	19.6113	19.7793	19.7943	19.7992	19.7298	19.2489	18.4356	17.6950	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.0708	18.3613	18.8732	19.4598	19.8523	20.0192	20.0374	20.0408	19.9664	19.4995	18.7318	18.0380	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9208	18.2113	18.7232	19.3098	19.7023	19.8692	19.8874	19.8908	19.8164	19.3495	18.5818	17.8880	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9345	0.8859	0.7837	0.6176	0.3769	0.2085	0.2315	0.5281	0.8118	0.9263	0.9623	(94)
Useful gains	789.5755	883.7214	950.6361	958.6718	796.2449	498.3409	261.8126	273.6311	568.6382	754.6606	765.8043	745.9581	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1735.9358	1696.7401	1523.4385	1254.6229	893.6282	510.2210	262.7623	274.9946	608.7478	1027.4185	1402.9168	1710.0711	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	704.0921	546.3485	426.1650	213.0848	72.4531	0.0000	0.0000	0.0000	0.0000	202.9319	458.7210	717.3000	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3341.0964 (98)
RHI space heating demand	3341 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5732	0.5620	0.5507	0.4945	0.4833	0.4271	0.4271	0.4159	0.4496	0.4833	0.5058	0.5283	(22b)
Effective ac	0.6643	0.6579	0.6517	0.6223	0.6168	0.5912	0.5912	0.5865	0.6011	0.6168	0.6279	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0546	54.5259	54.0076	51.5733	51.1179	48.9977	48.9977	48.6051	49.8144	51.1179	52.0393	53.0025	(38)
Heat transfer coeff	139.7814	139.2527	138.7344	136.3002	135.8447	133.7245	133.7245	133.3319	134.5412	135.8447	136.7661	137.7293	(39)
Average = Sum(39)m / 12 =												136.2980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4357	1.4303	1.4250	1.4000	1.3953	1.3735	1.3735	1.3695	1.3819	1.3953	1.4047	1.4146	(40)
HLP (average)												1.3999	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Daily hot water use
              108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte  160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
               57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
               76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
              620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	10.6334	0.4600	0.0000	0.7700	23.6527	(74)
East	7.7400	19.6403	0.4600	0.0000	0.7700	53.8439	(76)
South	2.6200	46.7521	0.4600	0.0000	0.7700	43.3861	(78)
West	1.3100	19.6403	0.4600	0.0000	0.7700	9.1131	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

```
Solar gains    185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains    805.3760   945.2984  1076.8599  1205.9274  1286.8600  1263.7420  1208.7515  1126.8365  1034.9030   903.4037   795.6027   759.5601 (84)
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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                  21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            34.6996    34.8314    34.9615    35.5859    35.7052    36.2713    36.2713    36.3781    36.0512    35.7052    35.4647    35.2167
alpha           3.3133     3.3221     3.3308     3.3724     3.3803     3.4181     3.4181     3.4252     3.4034     3.3803     3.3643     3.3478
util living area
                0.9805     0.9664     0.9379     0.8746     0.7645     0.6070     0.4645     0.5112     0.7292     0.9074     0.9683     0.9837 (86)

MIT            19.2018    19.4517    19.8312    20.3024    20.6717    20.8952    20.9683    20.9559    20.7954    20.3035    19.6747    19.1677 (87)
Th 2           19.7361    19.7402    19.7442    19.7634    19.7670    19.7837    19.7837    19.7868    19.7772    19.7670    19.7597    19.7521 (88)
util rest of house
                0.9757     0.9582     0.9225     0.8432     0.7063     0.5143     0.3457     0.3901     0.6448     0.8771     0.9591     0.9797 (89)
MIT 2          17.3970    17.7587    18.3018    18.9663    19.4452    19.7090    19.7701    19.7660    19.6107    18.9878    18.0973    17.3577 (90)
Living area fraction                                                                                    fLA = Living area / (4) =       0.2028 (91)
MIT            17.7629    18.1020    18.6119    19.2372    19.6939    19.9495    20.0130    20.0073    19.8509    19.2546    18.4172    17.7247 (92)
Temperature adjustment                                                                                                               -0.1500
adjusted MIT   17.6129    17.9520    18.4619    19.0872    19.5439    19.7995    19.8630    19.8573    19.7009    19.1046    18.2672    17.5747 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9637     0.9419     0.9018     0.8224     0.6943     0.5156     0.3538     0.3975     0.6388     0.8560     0.9433     0.9691 (94)
Useful gains  776.1013   890.3343   971.0675   991.7068   893.4087   651.6070   427.6845   447.9651   661.1044   773.3468   750.4979   736.0656 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1860.9015  1817.5223  1659.5208  1388.5161  1065.5549   695.3004   436.3474   460.9654   753.5575  1155.2982  1527.2875  1842.0850 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              807.0913   623.0703   512.2093   285.7027   128.0768     0.0000     0.0000     0.0000     0.0000   284.1718   559.2885   822.8785 (98)
Space heating                                                                                                                       4022.4892 (98)
```

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Space heating per m2 (98) / (4) = 41.3156 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4444.7394	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	807.0913	623.0703	512.2093	285.7027	128.0768	0.0000	0.0000	0.0000	0.0000	284.1718	559.2885	822.8785	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	891.8136	688.4755	565.9771	315.6935	141.5213	0.0000	0.0000	0.0000	0.0000	314.0020	617.9984	909.2580	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9125	89.8490	89.7197	89.4209	88.8260	87.3000	87.3000	87.3000	87.3000	89.3902	89.7781	89.9356	(217)
Fuel for water heating, kWh/month													
	194.7095	170.8528	177.6008	156.8183	152.5719	135.5997	127.2799	143.7432	144.7757	162.8217	175.0672	189.0000	(219)
Water heating fuel used												1930.8405	(219)
Annual totals kWh/year													
Space heating fuel - main system												4444.7394	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Total delivered energy for all uses												6847.5435	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4444.7394	3.4800	154.6769	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1930.8405	3.4800	67.1932	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Total energy cost			404.1222	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1923	(257)
SAP value		83.3679	
SAP rating (Section 12)		83	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4444.7394	0.2160	960.0637	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1930.8405	0.2160	417.0615	(264)
Space and water heating			1377.1253	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Total kg/year			1622.0743	(272)
CO2 emissions per m2			16.6600	(273)
EI value			84.7318	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8884 = 3.917, stars = 4

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water heating environmental impact 0.216 / 0.8884 = 0.2431, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4721	0.4496	0.4496	0.4159	0.4159	0.3709	0.3822	0.3597	0.3709	0.3934	0.3934	0.4271	(22b)
Effective ac	0.6114	0.6011	0.6011	0.5865	0.5865	0.5688	0.5730	0.5647	0.5688	0.5774	0.5774	0.5912	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6729	49.8144	49.8144	48.6051	48.6051	47.1393	47.4900	46.7990	47.1393	47.8513	47.8513	48.9977	(38)
Heat transfer coeff	135.3997	134.5412	134.5412	133.3319	133.3319	131.8661	132.2169	131.5258	131.8661	132.5781	132.5781	133.7245	(39)
Average = Sum(39)m / 12 =												133.1251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3907	1.3819	1.3819	1.3695	1.3695	1.3544	1.3580	1.3509	1.3544	1.3617	1.3617	1.3735	(40)
HLP (average)												1.3673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

```
Daily hot water use
            108.5156  104.5695  100.6235   96.6775   92.7315   88.7855   88.7855   92.7315   96.6775  100.6235  104.5695  108.5156 (44)
Energy conte  160.9254  140.7464  145.2377  126.6217  121.4966  104.8423   97.1518  111.4831  112.8146  131.4745  143.5147  155.8477 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
              24.1388   21.1120   21.7857   18.9933   18.2245   15.7263   14.5728   16.7225   16.9222   19.7212   21.5272   23.3772 (46)
Water storage loss:
Total storage loss
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Combi loss    14.1428   12.7631   14.1051   13.6066   14.0270   13.5362   13.9636   14.0047   13.5746   14.0721   13.6572   14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
            175.0682  153.5095  159.3428  140.2283  135.5235  118.3785  111.1154  125.4878  126.3891  145.5466  157.1720  169.9783 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1717.7401 (64)
Heat gains from water heating, kWh/month
              57.0434   49.9890   51.8178   45.5034   43.9044   38.2441   35.7939   40.5693   40.9045   47.2333   51.1330   55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223  162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              56.1943   49.9113   40.5906   30.7297   22.9708   19.3929   20.9547   27.2377   36.5584   46.4193   54.1782   57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             376.1012  380.0040  370.1692  349.2320  322.8026  297.9627  281.3681  277.4654  287.3002  308.2373  334.6667  359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959   53.9959 (69)
Pumps, fans    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 -108.5482 (71)
Water heating gains (Table 5)
              76.6712   74.3883   69.6476   63.1991   59.0112   53.1168   48.1100   54.5286   56.8118   63.4856   71.0180   74.3979 (72)
Total internal gains
             620.2368  615.5736  591.6774  554.4309  516.0547  481.7425  461.7029  470.5018  491.9405  529.4124  571.1330  602.9307 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2800	11.9814	0.4600	0.0000	0.7700	26.6512	(74)
East	7.7400	22.3313	0.4600	0.0000	0.7700	61.2215	(76)
South	2.6200	50.9848	0.4600	0.0000	0.7700	47.3141	(78)
West	1.3100	22.3313	0.4600	0.0000	0.7700	10.3618	(80)
South	3.3300	50.9848	0.4600	0.0000	0.7700	60.1359	(78)

```
Solar gains  205.6845  330.1265  481.3461  668.7839  773.1314  840.3401  793.7295  711.5244  584.8199  400.2111  255.5800  172.2747 (83)
Total gains  825.9213  945.7001 1073.0235 1223.2148 1289.1861 1322.0826 1255.4324 1182.0262 1076.7603  929.6235  826.7130  775.2053 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          35.8226   36.0512   36.0512   36.3781   36.3781   36.7825   36.6849   36.8777   36.7825   36.5850   36.5850   36.2713
alpha         3.3882    3.4034    3.4034    3.4252    3.4252    3.4522    3.4457    3.4585    3.4522    3.4390    3.4390    3.4181
util living area
               0.9756    0.9611    0.9257    0.8414    0.6959    0.4750    0.3218    0.3496    0.6295    0.8726    0.9567    0.9796 (86)

MIT           19.4162   19.6299   20.0145   20.4675   20.7998   20.9628   20.9930   20.9909   20.8969   20.4852   19.8964   19.3867 (87)
Th 2          19.7705   19.7772   19.7772   19.7868   19.7868   19.7985   19.7957   19.8012   19.7985   19.7928   19.7928   19.7837 (88)
util rest of house
               0.9695    0.9515    0.9069    0.8021    0.6232    0.3705    0.1990    0.2217    0.5264    0.8308    0.9440    0.9743 (89)
MIT 2         17.7287   18.0387   18.5830   19.2035   19.6113   19.7793   19.7943   19.7992   19.7298   19.2489   18.4356   17.6950 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.2028 (91)
MIT           18.0708   18.3613   18.8732   19.4598   19.8523   20.0192   20.0374   20.0408   19.9664   19.4995   18.7318   18.0380 (92)
Temperature adjustment                                                                                                   -0.1500
adjusted MIT  17.9208   18.2113   18.7232   19.3098   19.7023   19.8692   19.8874   19.8908   19.8164   19.3495   18.5818   17.8880 (93)
```

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8. Space heating requirement

```
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation   0.9560    0.9345    0.8859    0.7837    0.6176    0.3769    0.2085    0.2315    0.5281    0.8118    0.9263    0.9623 (94)
Useful gains 789.5755  883.7214  950.6361  958.6718  796.2449  498.3409  261.8126  273.6311  568.6382  754.6606  765.8043  745.9581 (95)
Ext temp.     5.1000    5.6000    7.4000    9.9000   13.0000   16.0000   17.9000   17.8000   15.2000   11.6000    8.0000    5.1000 (96)
Heat loss rate W
            1735.9358 1696.7401 1523.4385 1254.6229  893.6282  510.2210  262.7623  274.9946  608.7478 1027.4185 1402.9168 1710.0711 (97)
Month fracti  1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             704.0921  546.3485  426.1650  213.0848   72.4531    0.0000    0.0000    0.0000    0.0000  202.9319  458.7210  717.3000 (98)
Space heating                                                                                                           3341.0964 (98)
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating per m2 (98) / (4) = 34.3169 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3691.8192 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	704.0921	546.3485	426.1650	213.0848	72.4531	0.0000	0.0000	0.0000	0.0000	202.9319	458.7210	717.3000	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	778.0023	603.7000	470.9005	235.4528	80.0587	0.0000	0.0000	0.0000	0.0000	224.2341	506.8740	792.5967	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8442	89.7782	89.6061	89.2023	88.3888	87.3000	87.3000	87.3000	87.3000	89.1354	89.6613	89.8689	(217)
Fuel for water heating, kWh/month	194.8575	170.9875	177.8258	157.2027	153.3266	135.5997	127.2799	143.7432	144.7757	163.2872	175.2952	189.1402	(219)
Water heating fuel used												1933.3212	(219)

Annual totals kWh/year	
Space heating fuel - main system	3691.8192 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	75.0000 (231)
Electricity for lighting (calculated in Appendix L)	396.9635 (232)
Total delivered energy for all uses	6097.1040 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3691.8192	3.9200	144.7193	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1933.3212	3.9200	75.7862	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	396.9635	16.9600	67.3250	(250)
Additional standing charges			88.0000	(251)
Total energy cost			388.5505	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3691.8192	0.2160	797.4330	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.3212	0.2160	417.5974	(264)
Space and water heating			1215.0303	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Total kg/year			1459.9794	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3691.8192	1.2200	4504.0195	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1933.3212	1.2200	2358.6519	(264)
Space and water heating			6862.6714	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)
Primary energy kWh/year			8311.5994	(272)
Primary energy kWh/m2/year			85.3698	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 83
Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 30	-189 kg (12.9%)
U Solar photovoltaic panels	+ 9.4	-£ 309	-947 kg (74.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.94 kg/m²	B 84	B 86
Solar photovoltaic panels	£309	9.72 kg/m²	A 94	A 95
Total Savings	£340	11.66 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£80	£89	-£8
Mains gas	£309	£270	£39
Space heating	£245	£245	£0
Water heating	£76	£45	£30
Lighting	£67	£67	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£389	£50	£340
Total cost of uses	£388	£48	£339
Delivered energy	63 kWh/m²	34 kWh/m²	28 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	85 kWh/m²	17 kWh/m²	68 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5732	0.5620	0.5507	0.4945	0.4833	0.4271	0.4271	0.4159	0.4496	0.4833	0.5058	0.5283	(22b)
Effective ac	0.6643	0.6579	0.6517	0.6223	0.6168	0.5912	0.5912	0.5865	0.6011	0.6168	0.6279	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	84.7268 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.0546	54.5259	54.0076	51.5733	51.1179	48.9977	48.9977	48.6051	49.8144	51.1179	52.0393	53.0025	(38)
Heat transfer coeff	139.7814	139.2527	138.7344	136.3002	135.8447	133.7245	133.7245	133.3319	134.5412	135.8447	136.7661	137.7293	(39)
Average = Sum(39)m / 12 =												136.2980	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4357	1.4303	1.4250	1.4000	1.3953	1.3735	1.3735	1.3695	1.3819	1.3953	1.4047	1.4146	(40)
HLP (average)												1.3999	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Daily hot water use
            108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
             24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss    14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1079.5246 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1813.6014 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.1684 (H8)
Utilisation factor                                                                                                                    0.5751 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.6505 (H14)
Volume ratio Veff/V                                                                                                                   0.7603 (H15)
Solar storage volume factor                                                                                                           0.9452 (H16)
Solar input                                                                                                                        -866.7922 (H17)
Solar input   -25.1352   -41.9435   -71.4346   -95.7364  -118.2743  -116.2825  -114.7457  -100.2539   -78.5189   -53.6192   -29.8140   -21.0339 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -866.7922 (63)
Output from w/h
            149.9330   111.5660    87.9082    44.4919    17.2493     2.0961     0.0000    25.2339    47.8702    91.9274   127.3579   148.9444 (64)
                                                                                Total per year (kWh/year) = Sum(64)m =     854.5783 (64)
Heat gains from water heating, kWh/month
             57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
           -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
              76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
             620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF             Access            Gains
                                         m2            Table 6a      Specific data      Specific data       factor                W
                                                         W/m2        or Table 6b        or Table 6c         Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
North                                  6.2800           10.6334           0.4600             0.0000           0.7700           23.6527 (74)
East                                   7.7400           19.6403           0.4600             0.0000           0.7700           53.8439 (76)
South                                  2.6200           46.7521           0.4600             0.0000           0.7700           43.3861 (78)
West                                   1.3100           19.6403           0.4600             0.0000           0.7700            9.1131 (80)
South                                  3.3300           46.7521           0.4600             0.0000           0.7700           55.1434 (78)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains   185.1392   329.7248   485.1825   651.4965   770.8053   781.9995   747.0485   656.3347   542.9625   373.9913   224.4697   156.6294 (83)
Total gains   805.3760   945.2984  1076.8599  1205.9274  1286.8600  1263.7420  1208.7515  1126.8365  1034.9030   903.4037   795.6027   759.5601 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.6996    34.8314    34.9615    35.5859    35.7052    36.2713    36.2713    36.3781    36.0512    35.7052    35.4647    35.2167
alpha         3.3133     3.3221     3.3308     3.3724     3.3803     3.4181     3.4181     3.4252     3.4034     3.3803     3.3643     3.3478
util living area
              0.9805     0.9664     0.9379     0.8746     0.7645     0.6070     0.4645     0.5112     0.7292     0.9074     0.9683     0.9837 (86)

MIT          19.2018    19.4517    19.8312    20.3024    20.6717    20.8952    20.9683    20.9559    20.7954    20.3035    19.6747    19.1677 (87)
Th 2          19.7361    19.7402    19.7442    19.7634    19.7670    19.7837    19.7837    19.7868    19.7772    19.7670    19.7597    19.7521 (88)
util rest of house
              0.9757     0.9582     0.9225     0.8432     0.7063     0.5143     0.3457     0.3901     0.6448     0.8771     0.9591     0.9797 (89)
MIT 2        17.3970    17.7587    18.3018    18.9663    19.4452    19.7090    19.7701    19.7660    19.6107    18.9878    18.0973    17.3577 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2028 (91)
MIT          17.7629    18.1020    18.6119    19.2372    19.6939    19.9495    20.0130    20.0073    19.8509    19.2546    18.4172    17.7247 (92)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment												-0.1500	
adjusted MIT	17.6129	17.9520	18.4619	19.0872	19.5439	19.7995	19.8630	19.8573	19.7009	19.1046	18.2672	17.5747	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9637	0.9419	0.9018	0.8224	0.6943	0.5156	0.3538	0.3975	0.6388	0.8560	0.9433	0.9691	(94)
Useful gains	776.1013	890.3343	971.0675	991.7068	893.4087	651.6070	427.6845	447.9651	661.1044	773.3468	750.4979	736.0656	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1860.9015	1817.5223	1659.5208	1388.5161	1065.5549	695.3004	436.3474	460.9654	753.5575	1155.2982	1527.2875	1842.0850	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	807.0913	623.0703	512.2093	285.7027	128.0768	0.0000	0.0000	0.0000	0.0000	284.1718	559.2885	822.8785	(98)
Space heating												4022.4892	(98)
Space heating per m2											(98) / (4) =	41.3156	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4444.7394	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	807.0913	623.0703	512.2093	285.7027	128.0768	0.0000	0.0000	0.0000	0.0000	284.1718	559.2885	822.8785	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	891.8136	688.4755	565.9771	315.6935	141.5213	0.0000	0.0000	0.0000	0.0000	314.0020	617.9984	909.2580	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9833	89.9990	90.0167	90.0552	90.1080	87.3000	87.3000	87.3000	87.3000	89.6964	89.8889	89.9944	(217)
Fuel for water heating, kWh/month	166.6232	123.9636	97.6577	49.4052	19.1429	2.4010	0.0000	28.9048	54.8342	102.4873	141.6838	165.5040	(219)
Water heating fuel used												952.6076	(219)
Annual totals kWh/year													
Space heating fuel - main system												4444.7394	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4192.0712	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4444.7394	3.4800	154.6769	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.6076	3.4800	33.1507	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			148.8518	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4392	(257)
SAP value		93.8738	
SAP rating (Section 12)		94	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4444.7394	0.2160	960.0637	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.6076	0.2160	205.7632	(264)
Space and water heating			1165.8270	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			540.2888	(272)
CO2 emissions per m2			5.5500	(273)
EI value			94.9144	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4496	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4496	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4721	0.4496	0.4496	0.4159	0.4159	0.3709	0.3822	0.3597	0.3709	0.3934	0.3934	0.4271	(22b)
Effective ac	0.6114	0.6011	0.6011	0.5865	0.5865	0.5688	0.5730	0.5647	0.5688	0.5774	0.5774	0.5912	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	73.0200	16.2100	56.8100	0.2500	14.2025	52.3000	2971.1630	(29a)
EW WBoard ACC015	74.0200	9.3300	64.6900	0.2400	15.5256	52.3000	3383.2870	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.0404			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 84.7268	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6729	49.8144	49.8144	48.6051	48.6051	47.1393	47.4900	46.7990	47.1393	47.8513	47.8513	48.9977	(38)
Heat transfer coeff	135.3997	134.5412	134.5412	133.3319	133.3319	131.8661	132.2169	131.5258	131.8661	132.5781	132.5781	133.7245	(39)
Average = Sum(39)m / 12 =												133.1251	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3907	1.3819	1.3819	1.3695	1.3695	1.3544	1.3580	1.3509	1.3544	1.3617	1.3617	1.3735	(40)
HLP (average)												1.3673	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

```
Daily hot water use
            108.5156   104.5695   100.6235    96.6775    92.7315    88.7855    88.7855    92.7315    96.6775   100.6235   104.5695   108.5156 (44)
Energy conte   160.9254   140.7464   145.2377   126.6217   121.4966   104.8423    97.1518   111.4831   112.8146   131.4745   143.5147   155.8477 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1552.1566 (45)
Distribution loss  (46)m = 0.15 x (45)m
             24.1388    21.1120    21.7857    18.9933    18.2245    15.7263    14.5728    16.7225    16.9222    19.7212    21.5272    23.3772 (46)
Water storage loss:
Total storage loss
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1428    12.7631    14.1051    13.6066    14.0270    13.5362    13.9636    14.0047    13.5746    14.0721    13.6572    14.1306 (61)
Total heat required for water heating calculated for each month
            175.0682   153.5095   159.3428   140.2283   135.5235   118.3785   111.1154   125.4878   126.3891   145.5466   157.1720   169.9783 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1140.0998 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             1915.3676 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.2340 (H8)
Utilisation factor                                                                                                                    0.5553 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               98.6505 (H14)
Volume ratio Veff/V                                                                                                                   0.7603 (H15)
Solar storage volume factor                                                                                                           0.9452 (H16)
Solar input                                                                                                                        -883.9623 (H17)
Solar input    -27.2079   -40.8934   -68.8697   -95.1991  -114.6517  -120.6659  -117.7685  -105.1680   -82.0840   -55.8402   -33.0719   -22.5419 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =  -883.9623 (63)
Output from w/h
            147.8603   112.6160    90.4731    45.0293    20.8719     0.0000     0.0000    20.3198    44.3052    89.7064   124.1000   147.4364 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    842.7184 (64)
Heat gains from water heating, kWh/month
             57.0434    49.9890    51.8178    45.5034    43.9044    38.2441    35.7939    40.5693    40.9045    47.2333    51.1330    55.3520 (65)
```

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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223   162.8223 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              56.1943    49.9113    40.5906    30.7297    22.9708    19.3929    20.9547    27.2377    36.5584    46.4193    54.1782    57.7561 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             376.1012   380.0040   370.1692   349.2320   322.8026   297.9627   281.3681   277.4654   287.3002   308.2373   334.6667   359.5066 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959    53.9959 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
           -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482  -108.5482 (71)
Water heating gains (Table 5)
              76.6712    74.3883    69.6476    63.1991    59.0112    53.1168    48.1100    54.5286    56.8118    63.4856    71.0180    74.3979 (72)
Total internal gains
             620.2368   615.5736   591.6774   554.4309   516.0547   481.7425   461.7029   470.5018   491.9405   529.4124   571.1330   602.9307 (73)
```

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6. Solar gains

```
[Jan]                                        Area          Solar flux              g                FF            Access            Gains
                                             m2          Table 6a      Specific data    Specific data      factor                W
                                                           W/m2       or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
North                                      6.2800          11.9814            0.4600           0.0000        0.7700          26.6512 (74)
East                                       7.7400          22.3313            0.4600           0.0000        0.7700          61.2215 (76)
South                                      2.6200          50.9848            0.4600           0.0000        0.7700          47.3141 (78)
West                                       1.3100          22.3313            0.4600           0.0000        0.7700          10.3618 (80)
South                                      3.3300          50.9848            0.4600           0.0000        0.7700          60.1359 (78)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    205.6845   330.1265   481.3461   668.7839   773.1314   840.3401   793.7295   711.5244   584.8199   400.2111   255.5800   172.2747 (83)
Total gains    825.9213   945.7001  1073.0235  1223.2148  1289.1861  1322.0826  1255.4324  1182.0262  1076.7603   929.6235   826.7130   775.2053 (84)
```

---

7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          35.8226    36.0512    36.0512    36.3781    36.3781    36.7825    36.6849    36.8777    36.7825    36.5850    36.5850    36.2713
alpha         3.3882     3.4034     3.4034     3.4252     3.4252     3.4522     3.4457     3.4585     3.4522     3.4390     3.4390     3.4181
util living area
              0.9756     0.9611     0.9257     0.8414     0.6959     0.4750     0.3218     0.3496     0.6295     0.8726     0.9567     0.9796 (86)

MIT          19.4162    19.6299    20.0145    20.4675    20.7998    20.9628    20.9930    20.9909    20.8969    20.4852    19.8964    19.3867 (87)
Th 2          19.7705    19.7772    19.7772    19.7868    19.7868    19.7985    19.7957    19.8012    19.7985    19.7928    19.7928    19.7837 (88)
util rest of house
              0.9695     0.9515     0.9069     0.8021     0.6232     0.3705     0.1990     0.2217     0.5264     0.8308     0.9440     0.9743 (89)
MIT 2        17.7287    18.0387    18.5830    19.2035    19.6113    19.7793    19.7943    19.7992    19.7298    19.2489    18.4356    17.6950 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2028 (91)
MIT          18.0708    18.3613    18.8732    19.4598    19.8523    20.0192    20.0374    20.0408    19.9664    19.4995    18.7318    18.0380 (92)
```

Temperature adjustment												-0.1500	
adjusted MIT	17.9208	18.2113	18.7232	19.3098	19.7023	19.8692	19.8874	19.8908	19.8164	19.3495	18.5818	17.8880	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9560	0.9345	0.8859	0.7837	0.6176	0.3769	0.2085	0.2315	0.5281	0.8118	0.9263	0.9623	(94)
Useful gains	789.5755	883.7214	950.6361	958.6718	796.2449	498.3409	261.8126	273.6311	568.6382	754.6606	765.8043	745.9581	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1735.9358	1696.7401	1523.4385	1254.6229	893.6282	510.2210	262.7623	274.9946	608.7478	1027.4185	1402.9168	1710.0711	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	704.0921	546.3485	426.1650	213.0848	72.4531	0.0000	0.0000	0.0000	0.0000	202.9319	458.7210	717.3000	(98)
Space heating												3341.0964	(98)
Space heating per m2											(98) / (4) =	34.3169	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3691.8192	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	704.0921	546.3485	426.1650	213.0848	72.4531	0.0000	0.0000	0.0000	0.0000	202.9319	458.7210	717.3000	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	778.0023	603.7000	470.9005	235.4528	80.0587	0.0000	0.0000	0.0000	0.0000	224.2341	506.8740	792.5967	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	147.8603	112.6160	90.4731	45.0293	20.8719	0.0000	0.0000	20.3198	44.3052	89.7064	124.1000	147.4364	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9279	89.9366	89.9228	89.9250	89.7641	87.3000	87.3000	87.3000	87.3000	89.4944	89.7991	89.9379	(217)
Fuel for water heating, kWh/month	164.4209	125.2171	100.6120	50.0743	23.2519	0.0000	0.0000	23.2759	50.7505	100.2369	138.1974	163.9313	(219)
Water heating fuel used												939.9681	(219)
Annual totals kWh/year													
Space heating fuel - main system												3691.8192	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3329.5912	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3691.8192	3.9200	144.7193	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	939.9681	3.9200	36.8467	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	396.9635	16.9600	67.3250	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			48.7136	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3691.8192	0.2160	797.4330	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	939.9681	0.2160	203.0331	(264)
Space and water heating			1000.4661	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			324.6263 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3691.8192	1.2200	4504.0195 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	939.9681	1.2200	1146.7611 (264)
Space and water heating			5650.7805 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	396.9635	3.0700	1218.6781 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			1653.0385 (272)
Primary energy kWh/m2/year			16.9786 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	331.51 (P1)
Transmission heat loss coefficient	84.73 (37)
Summer heat loss coefficient	416.23 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	6.2800	81.1852	0.4600	0.0000	0.9000	211.0750
East	7.7400	117.5071	0.4600	0.0000	0.9000	376.5349
South	2.6200	112.2060	0.4600	0.0000	0.9000	121.7076
West	1.3100	117.5071	0.4600	0.0000	0.9000	63.7288
South	3.3300	112.2060	0.4600	0.0000	0.9000	154.6894
total:						927.7357

	Jun	Jul	Aug	
Solar gains	982	928	832	(P4)
Internal gains	479	459	468	
Total summer gains	1461	1386	1299	(P5)
Summer gain/loss ratio	3.51	3.33	3.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	20.25	21.98	21.67	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

AES Sustainability Consultants

Property Reference	4907-P637-6633-354	**Issued on Date**	19/10/2022
Assessment Reference	Plot 354	**Prop Type Ref**	Maplethorne-As-DET
Property	Plot 354, 3 Bed, K, WC, B, En		

SAP Rating	84 B	**DER**	17.59	**TER**	18.49
Environmental	85 B	**% DER<TER**	4.88		
CO_2 Emissions (t/year)	1.39	**DFEE**	50.36	**TFEE**	56.71
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.20		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessc.co.uk	**Assessor ID**	P637-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 96 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.49 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.59 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.4 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 5.06 m², No overhang
Windows facing East: 0.72 m², No overhang
Windows facing South: 7.64 m², No overhang
Windows facing West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.4122	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
											Total per year (kWh/year) = Sum(64)m =	1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	571.1581	676.4620	756.1957	818.4503	851.1811	826.4642	791.9292	754.3507	716.3746	643.4640	567.6036	536.4095	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9910	0.9834	0.9693	0.9378	0.8724	0.7501	0.6050	0.6459	0.8326	0.9505	0.9847	0.9927	(86)
MIT	19.0502	19.2791	19.6266	20.0786	20.4910	20.8026	20.9323	20.9135	20.6893	20.1508	19.5235	19.0196	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9888	0.9794	0.9614	0.9203	0.8327	0.6668	0.4757	0.5207	0.7671	0.9331	0.9803	0.9910	(89)
MIT 2	17.2449	17.5795	18.0845	18.7404	19.3097	19.7084	19.8352	19.8241	19.5806	18.8539	17.9477	17.2088	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.5195	17.8380	18.3191	18.9440	19.4894	19.8749	20.0021	19.9898	19.7492	19.0512	18.1874	17.4842	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3695	17.6880	18.1691	18.7940	19.3394	19.7249	19.8521	19.8398	19.5992	18.9012	18.0374	17.3342	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9682	0.9451	0.8986	0.8103	0.6544	0.4734	0.5166	0.7482	0.9126	0.9695	0.9847	(94)
Useful gains	560.5703	654.9170	714.6730	735.4328	689.7029	540.8114	374.9131	389.6767	535.9858	587.2293	550.2754	528.2158	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1645.2096	1604.1784	1458.8042	1216.9537	936.7560	619.4263	393.0680	414.6395	668.3918	1017.9065	1349.5113	1631.0397	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	806.9716	637.9037	553.6336	346.6950	183.8075	0.0000	0.0000	0.0000	0.0000	320.4239	575.4499	820.5010	(98)
Space heating												4245.3861	(98)
Space heating per m2											(98) / (4) =	44.3568	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4691.0344	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	806.9716	637.9037	553.6336	346.6950	183.8075	0.0000	0.0000	0.0000	0.0000	320.4239	575.4499	820.5010	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	891.6813	704.8659	611.7499	383.0884	203.1022	0.0000	0.0000	0.0000	0.0000	354.0595	635.8562	906.6310	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9143	89.8631	89.7668	89.5572	89.1167	87.3000	87.3000	87.3000	87.3000	89.4782	89.7960	89.9361	(217)
Fuel for water heating, kWh/month													
	193.9454	170.1607	176.8202	155.9778	151.4940	135.0886	126.8064	143.1997	144.2255	162.0374	174.3534	188.2630	(219)
Water heating fuel used												1922.3720	(219)
Annual totals kWh/year													
Space heating fuel - main system												4691.0344	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7104.4857	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4691.0344	0.2160	1013.2634	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.3720	0.2160	415.2323	(264)
Space and water heating			1428.4958	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/year			1683.3660	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.5900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.5900	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		34.9384	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.9384	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.6300	0.7000	0.7700	16.4435	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	7.6400	46.7521	0.6300	0.7000	0.7700	109.1606	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	134.2475	227.1095	308.9732	383.7657	433.5212	432.7543	416.1804	378.2003	334.4777	250.2973	160.4550	115.1408	(83)
Total gains	562.1867	652.7313	719.4586	769.1990	793.3578	768.1032	736.2111	705.3298	674.9703	616.0665	554.4758	530.4798	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9982	0.9959	0.9904	0.9741	0.9266	0.8067	0.6422	0.6863	0.8870	0.9802	0.9962	0.9986	(86)
MIT	19.6433	19.8023	20.0486	20.3731	20.6755	20.8958	20.9740	20.9640	20.8166	20.4250	19.9766	19.6204	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9975	0.9945	0.9869	0.9633	0.8928	0.7191	0.5039	0.5516	0.8236	0.9698	0.9946	0.9981	(89)
MIT 2	18.0934	18.3274	18.6879	19.1644	19.5827	19.8559	19.9210	19.9176	19.7716	19.2449	18.5924	18.0678	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.3291	18.5518	18.8949	19.3483	19.7490	20.0141	20.0812	20.0768	19.9306	19.4244	18.8030	18.3040	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3291	18.5518	18.8949	19.3483	19.7490	20.0141	20.0812	20.0768	19.9306	19.4244	18.8030	18.3040	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9918	0.9821	0.9556	0.8861	0.7269	0.5247	0.5713	0.8239	0.9631	0.9920	0.9970	(94)
Useful gains	559.9961	647.3865	706.5718	735.0242	703.0271	558.3259	386.2677	402.9841	556.0768	593.3440	550.0583	528.9040	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1649.5255	1600.3084	1448.6587	1204.0605	925.0982	614.5485	395.1516	416.3835	665.0257	1014.2237	1352.3154	1638.8855	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	810.6098	640.3635	552.1127	337.7061	165.2209	0.0000	0.0000	0.0000	0.0000	313.1344	577.6251	825.8263	(98)
Space heating												4222.5988	(98)
Space heating per m2											(98) / (4) =	44.1187	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4520.9838	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	810.6098	640.3635	552.1127	337.7061	165.2209	0.0000	0.0000	0.0000	0.0000	313.1344	577.6251	825.8263	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	867.8906	685.6140	591.1271	361.5697	176.8961	0.0000	0.0000	0.0000	0.0000	335.2617	618.4423	884.1823	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1094	87.9094	87.5205	86.6982	85.0087	80.3000	80.3000	80.3000	80.3000	86.4069	87.6474	88.1843	(217)
Fuel for water heating, kWh/month													
	239.7049	211.7833	223.4690	200.1885	197.6697	184.3053	176.5785	196.8436	199.0176	210.4883	219.3125	233.7674	(219)
Water heating fuel used												2493.1286	(219)
Annual totals kWh/year													
Space heating fuel - main system												4520.9838	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												7505.1918	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4520.9838	0.2160	976.5325	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2493.1286	0.2160	538.5158	(264)
Space and water heating			1515.0483	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1769.9185	(272)
Emissions per m2 for space and water heating			15.8296	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8296 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.4900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3718	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3718	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4740	0.4647	0.4554	0.4089	0.3996	0.3532	0.3532	0.3439	0.3718	0.3996	0.4182	0.4368	(22b)
Effective ac	0.6123	0.6080	0.6037	0.5836	0.5799	0.5624	0.5624	0.5591	0.5691	0.5799	0.5875	0.5954	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9941	49.6379	49.2889	47.6492	47.3424	45.9144	45.9144	45.6499	46.4644	47.3424	47.9630	48.6118	(38)
Heat transfer coeff	123.7787	123.4226	123.0735	121.4339	121.1271	119.6990	119.6990	119.4345	120.2491	121.1271	121.7477	122.3965	(39)
Average = Sum(39)m / 12 =												121.4324	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2933	1.2895	1.2859	1.2688	1.2656	1.2506	1.2506	1.2479	1.2564	1.2656	1.2720	1.2788	(40)
HLP (average)												1.2688	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	537.5606	643.6876	725.1304	789.7124	823.9553	801.3652	768.6345	728.7406	689.9392	614.6203	536.0442	503.6316	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.2409	36.3455	36.4486	36.9407	37.0343	37.4761	37.4761	37.5591	37.3047	37.0343	36.8455	36.6502	
alpha	3.4161	3.4230	3.4299	3.4627	3.4690	3.4984	3.4984	3.5039	3.4870	3.4690	3.4564	3.4433	
util living area													
	0.9925	0.9856	0.9724	0.9425	0.8794	0.7599	0.6149	0.6581	0.8427	0.9557	0.9871	0.9940	(86)
MIT	19.0434	19.2727	19.6204	20.0696	20.4839	20.7975	20.9303	20.9100	20.6804	20.1366	19.5085	19.0084	(87)
Th 2	19.8461	19.8490	19.8519	19.8654	19.8679	19.8797	19.8797	19.8819	19.8752	19.8679	19.8628	19.8575	(88)
util rest of house													
	0.9907	0.9821	0.9653	0.9262	0.8413	0.6780	0.4857	0.5334	0.7797	0.9399	0.9833	0.9926	(89)
MIT 2	18.0705	18.3002	18.6463	19.0952	19.4876	19.7654	19.8549	19.8468	19.6737	19.1681	18.5462	18.0440	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2185	18.4482	18.7945	19.2434	19.6391	19.9224	20.0185	20.0086	19.8268	19.3155	18.6926	18.1907	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2185	18.4482	18.7945	19.2434	19.6391	19.9224	20.0185	20.0086	19.8268	19.3155	18.6926	18.1907	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9871	0.9762	0.9566	0.9148	0.8320	0.6815	0.5032	0.5491	0.7764	0.9298	0.9779	0.9895	(94)
Useful gains	530.5998	628.3833	693.6256	722.4425	685.5564	546.1562	386.7909	400.1348	535.6712	571.4501	524.1761	498.3518	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1722.8169	1672.1505	1513.1254	1256.0425	961.6435	637.0874	409.1910	430.9870	688.6461	1055.6774	1411.3720	1712.4142	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	887.0095	701.4115	609.7078	384.1920	205.4089	0.0000	0.0000	0.0000	0.0000	360.2651	638.7810	903.2624	(98)
Space heating												4690.0383	(98)
Space heating per m2											(98) / (4) =	49.0026	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1125.1706	885.7726	907.7025	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7461	0.8221	0.7972	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	839.4672	728.1943	723.6302	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.8324	999.4253	954.7774	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	144.2630	201.7958	171.9735	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												518.0322	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	36.0657	50.4490	42.9934	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												129.5081	(107)
Space cooling per m2												1.3531	(108)
Energy for space heating												49.0026	(99)
Energy for space cooling												1.3531	(108)
Total												50.3557	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.4	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1213	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3713	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3713	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.6300	0.7000	0.7700	16.4435	(74)
East	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(76)
South	7.6400	46.7521	0.6300	0.7000	0.7700	109.1606	(78)
West	0.7200	19.6403	0.6300	0.7000	0.7700	4.3217	(80)

Solar gains	134.2475	227.1095	308.9732	383.7657	433.5212	432.7543	416.1804	378.2003	334.4777	250.2973	160.4550	115.1408	(83)
Total gains	516.2177	607.5812	676.0092	728.7006	755.0332	732.5650	702.4693	668.6135	636.7633	574.8275	510.5348	485.3263	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9987	0.9970	0.9926	0.9789	0.9375	0.8271	0.6665	0.7137	0.9048	0.9849	0.9973	0.9991	(86)
MIT	19.5992	19.7594	20.0084	20.3382	20.6490	20.8825	20.9695	20.9573	20.7947	20.3883	19.9347	19.5768	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9983	0.9959	0.9898	0.9699	0.9074	0.7428	0.5260	0.5782	0.8473	0.9768	0.9962	0.9988	(89)
MIT 2	18.6217	18.7838	19.0338	19.3699	19.6670	19.8718	19.9229	19.9202	19.8049	19.4239	18.9701	18.6084	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.7704	18.9322	19.1821	19.5172	19.8164	20.0255	20.0821	20.0780	19.9554	19.5706	19.1168	18.7557	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7704	18.9322	19.1821	19.5172	19.8164	20.0255	20.0821	20.0780	19.9554	19.5706	19.1168	18.7557	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9946	0.9872	0.9655	0.9039	0.7515	0.5475	0.5985	0.8492	0.9732	0.9950	0.9982	(94)
Useful gains	514.9980	604.2909	667.3695	703.5544	682.4457	550.4975	384.5888	400.1671	540.7616	559.4134	507.9681	484.4758	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1701.4034	1644.8993	1482.2188	1223.5250	932.8476	615.8521	395.2497	416.5182	667.8617	1031.0236	1388.5797	1691.3759	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	882.6856	699.2889	606.2479	374.3789	186.2990	0.0000	0.0000	0.0000	0.0000	350.8780	634.0404	897.9337	(98)
Space heating												4631.7524	(98)
Space heating per m2											(98) / (4) =	48.3936	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7837	0.8669	0.8420	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	836.1540	728.1543	724.6957	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	959.4166	922.0893	884.4990	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	88.7490	144.2876	118.8936	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												351.9302 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	22.1873	36.0719	29.7234	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												87.9826 (107)
Space cooling per m2												0.9193 (108)
Energy for space heating												48.3936 (99)
Energy for space cooling												0.9193 (108)
Total												49.3129 (109)
Target Fabric Energy Efficiency (TFEE)												56.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4122	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	11.9814	0.4600	0.0000	0.7700	21.4738	(74)
East	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(76)
South	4.3100	50.9848	0.4600	0.0000	0.7700	77.8335	(78)
West	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(80)
South	3.3300	50.9848	0.4600	0.0000	0.7700	60.1359	(78)

Solar gains	170.8332	260.0819	350.4714	451.5532	500.1267	535.7859	509.0778	470.6161	412.1760	306.2298	209.1605	145.1308	(83)
Total gains	788.8347	873.0841	939.2574	1002.8764	1013.0103	1014.4848	968.0173	938.6728	902.0018	833.7428	778.4435	746.0945	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6931	36.9077	36.9077	37.2143	37.2143	37.5928	37.5015	37.6817	37.5928	37.4080	37.4080	37.1142	
alpha	3.4462	3.4605	3.4605	3.4810	3.4810	3.5062	3.5001	3.5121	3.5062	3.4939	3.4939	3.4743	
util living area													
	0.9730	0.9606	0.9336	0.8734	0.7573	0.5467	0.3747	0.3955	0.6661	0.8777	0.9537	0.9768	(86)
MIT	19.4935	19.6746	20.0043	20.4057	20.7464	20.9457	20.9896	20.9875	20.8822	20.4906	19.9482	19.4669	(87)
Th 2	19.8586	19.8645	19.8645	19.8727	19.8727	19.8828	19.8804	19.8851	19.8828	19.8779	19.8779	19.8701	(88)
util rest of house													
	0.9666	0.9515	0.9176	0.8414	0.6932	0.4403	0.2434	0.2626	0.5698	0.8399	0.9412	0.9713	(89)
MIT 2	17.9045	18.1677	18.6372	19.1977	19.6350	19.8514	19.8779	19.8819	19.7980	19.3262	18.5729	17.8740	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1463	18.3969	18.8452	19.3815	19.8041	20.0179	20.0470	20.0501	19.9630	19.5033	18.7821	18.1163	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9963	18.2469	18.6952	19.2315	19.6541	19.8679	19.8970	19.9001	19.8130	19.3533	18.6321	17.9663	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9518	0.9337	0.8959	0.8191	0.6790	0.4388	0.2454	0.2645	0.5631	0.8178	0.9220	0.9579	(94)
Useful gains	750.8409	815.1734	841.5082	821.4934	687.8725	445.1716	237.5356	248.2390	507.8827	681.8274	717.7544	714.6628	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1576.6128	1537.1410	1372.8443	1124.8300	802.0956	461.5430	238.8811	250.0034	550.4533	929.7538	1274.9691	1555.1015	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	614.3743	485.1622	395.3141	218.4023	84.9820	0.0000	0.0000	0.0000	0.0000	184.4573	401.1947	625.2864	(98)
Space heating												3009.1733	(98)
RHI space heating demand												3009	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.4122	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004	(36)
Total fabric heat loss	(33) + (36) =	73.7846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	773.5919	876.2181	946.8805	996.1008	1015.3269	980.2535	941.2850	906.3842	877.4794	817.6031	755.2474	734.4099	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9781	0.9656	0.9440	0.8997	0.8174	0.6773	0.5283	0.5635	0.7579	0.9096	0.9653	0.9814	(86)
MIT	19.2921	19.5088	19.8313	20.2431	20.6028	20.8591	20.9557	20.9437	20.7773	20.3199	19.7408	19.2595	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9731	0.9578	0.9308	0.8746	0.7688	0.5903	0.4077	0.4444	0.6819	0.8819	0.9561	0.9771	(89)
MIT 2	17.5944	17.9083	18.3721	18.9614	19.4443	19.7602	19.8484	19.8430	19.6723	19.0800	18.2576	17.5560	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8526	18.1518	18.5940	19.1564	19.6206	19.9274	20.0169	20.0104	19.8404	19.2686	18.4833	17.8152	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7026	18.0018	18.4440	19.0064	19.4706	19.7774	19.8669	19.8604	19.6904	19.1186	18.3333	17.6652	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9597	0.9407	0.9098	0.8514	0.7495	0.5823	0.4073	0.4430	0.6684	0.8588	0.9389	0.9651	(94)
Useful gains	742.4384	824.2328	861.4337	848.0820	760.9945	570.8089	383.4147	401.5335	586.4672	702.1978	709.1077	708.7896	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1687.1449	1643.5383	1493.1797	1243.0760	952.8409	625.7694	394.8557	417.1245	679.4706	1044.5713	1386.0139	1672.1364	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	702.8616	550.5733	470.0190	284.3956	142.7337	0.0000	0.0000	0.0000	0.0000	254.7259	487.3725	716.7300	(98)
Space heating												3609.4117	(98)
Space heating per m2											(98) / (4) =	37.7120	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3988.3002	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.8616	550.5733	470.0190	284.3956	142.7337	0.0000	0.0000	0.0000	0.0000	254.7259	487.3725	716.7300	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	776.6427	608.3683	519.3580	314.2493	157.7168	0.0000	0.0000	0.0000	0.0000	281.4651	538.5331	791.9668	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8453	89.7846	89.6702	89.4204	88.9157	87.3000	87.3000	87.3000	87.3000	89.3125	89.7006	89.8705	(217)
Fuel for water heating, kWh/month													
	194.0943	170.3094	177.0107	156.2165	151.8364	135.0886	126.8064	143.1997	144.2255	162.3381	174.5389	188.4003	(219)
Water heating fuel used												1924.0648	(219)
Annual totals kWh/year													
Space heating fuel - main system												3988.3002	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												6403.4444	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3988.3002	3.4800	138.7928	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1924.0648	3.4800	66.9575	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Total energy cost			390.5237	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1657	(257)
SAP value		83.7391	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3988.3002	0.2160	861.4728	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1924.0648	0.2160	415.5980	(264)
Space and water heating			1277.0708	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1531.9410	(272)
CO2 emissions per m2			16.0100	(273)
EI value			85.4111	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (64)

Total per year (kWh/year) = Sum(64)m = 1711.1415 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	11.9814	0.4600	0.0000	0.7700	21.4738	(74)
East	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(76)
South	4.3100	50.9848	0.4600	0.0000	0.7700	77.8335	(78)
West	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(80)
South	3.3300	50.9848	0.4600	0.0000	0.7700	60.1359	(78)

Solar gains	170.8332	260.0819	350.4714	451.5532	500.1267	535.7859	509.0778	470.6161	412.1760	306.2298	209.1605	145.1308	(83)
Total gains	788.8347	873.0841	939.2574	1002.8764	1013.0103	1014.4848	968.0173	938.6728	902.0018	833.7428	778.4435	746.0945	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6931	36.9077	36.9077	37.2143	37.2143	37.5928	37.5015	37.6817	37.5928	37.4080	37.4080	37.1142	
alpha	3.4462	3.4605	3.4605	3.4810	3.4810	3.5062	3.5001	3.5121	3.5062	3.4939	3.4939	3.4743	
util living area	0.9730	0.9606	0.9336	0.8734	0.7573	0.5467	0.3747	0.3955	0.6661	0.8777	0.9537	0.9768	(86)
MIT	19.4935	19.6746	20.0043	20.4057	20.7464	20.9457	20.9896	20.9875	20.8822	20.4906	19.9482	19.4669	(87)
Th 2	19.8586	19.8645	19.8645	19.8727	19.8727	19.8828	19.8804	19.8851	19.8828	19.8779	19.8779	19.8701	(88)
util rest of house	0.9666	0.9515	0.9176	0.8414	0.6932	0.4403	0.2434	0.2626	0.5698	0.8399	0.9412	0.9713	(89)
MIT 2	17.9045	18.1677	18.6372	19.1977	19.6350	19.8514	19.8779	19.8819	19.7980	19.3262	18.5729	17.8740	(90)

Living area fraction fLA = Living area / (4) = 0.1521 (91)

MIT	18.1463	18.3969	18.8452	19.3815	19.8041	20.0179	20.0470	20.0501	19.9630	19.5033	18.7821	18.1163	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9963	18.2469	18.6952	19.2315	19.6541	19.8679	19.8970	19.9001	19.8130	19.3533	18.6321	17.9663	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9518	0.9337	0.8959	0.8191	0.6790	0.4388	0.2454	0.2645	0.5631	0.8178	0.9220	0.9579	(94)
Useful gains	750.8409	815.1734	841.5082	821.4934	687.8725	445.1716	237.5356	248.2390	507.8827	681.8274	717.7544	714.6628	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1576.6128	1537.1410	1372.8443	1124.8300	802.0956	461.5430	238.8811	250.0034	550.4533	929.7538	1274.9691	1555.1015	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	614.3743	485.1622	395.3141	218.4023	84.9820	0.0000	0.0000	0.0000	0.0000	184.4573	401.1947	625.2864	(98)

Space heating 3009.1733 (98)

Space heating per m2 (98) / (4) = 31.4405 (99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3325.0534	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	614.3743	485.1622	395.3141	218.4023	84.9820	0.0000	0.0000	0.0000	0.0000	184.4573	401.1947	625.2864	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	678.8666	536.0909	436.8111	241.3286	93.9028	0.0000	0.0000	0.0000	0.0000	203.8202	443.3090	690.9242	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7725	89.7119	89.5595	89.2242	88.5090	87.3000	87.3000	87.3000	87.3000	89.0632	89.5783	89.7986	(217)
Fuel for water heating, kWh/month													
	194.2518	170.4474	177.2296	156.5599	152.5342	135.0886	126.8064	143.1997	144.2255	162.7924	174.7771	188.5512	(219)
Water heating fuel used												1926.4638	(219)
Annual totals kWh/year													
Space heating fuel - main system												3325.0534	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												416.0794	(232)
Total delivered energy for all uses												5742.5965	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3325.0534	3.9200	130.3421	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1926.4638	3.9200	75.5174	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Total energy cost			377.1465	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3325.0534	0.2160	718.2115	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.4638	0.2160	416.1162	(264)
Space and water heating			1134.3277	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total kg/year			1389.1979	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3325.0534	1.2200	4056.5651	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.4638	1.2200	2350.2858	(264)
Space and water heating			6406.8509	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Primary energy kWh/year			7914.4645	(272)
Primary energy kWh/m2/year			82.6921	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current environmental impact rating: B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 30	-188 kg (13.5%)
U Solar photovoltaic panels	+ 9.5	-£ 309	-947 kg (78.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.97 kg/m²	B 85	B 87
Solar photovoltaic panels	£309	9.89 kg/m²	A 94	A 96
Total Savings	£340	11.86 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£83	£92	-£8
Mains gas	£294	£255	£39
Space heating	£231	£231	£0
Water heating	£76	£45	£30
Lighting	£71	£71	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£377	£38	£340
Total cost of uses	£378	£38	£339
Delivered energy	60 kWh/m²	31 kWh/m²	29 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	83 kWh/m²	13 kWh/m²	70 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5255	0.5152	0.5049	0.4534	0.4431	0.3916	0.3916	0.3813	0.4122	0.4431	0.4637	0.4843	(22b)
Effective ac	0.6381	0.6327	0.6275	0.6028	0.5982	0.5767	0.5767	0.5727	0.5849	0.5982	0.6075	0.6173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0968	51.6590	51.2299	49.2143	48.8372	47.0817	47.0817	46.7566	47.7579	48.8372	49.6001	50.3977	(38)
Heat transfer coeff	125.8815	125.4437	125.0145	122.9990	122.6219	120.8664	120.8664	120.5413	121.5426	122.6219	123.3847	124.1823	(39)
Average = Sum(39)m / 12 =												122.9972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3152	1.3107	1.3062	1.2851	1.2812	1.2628	1.2628	1.2594	1.2699	1.2812	1.2892	1.2975	(40)
HLP (average)												1.2851	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1734	(H8)
Utilisation factor												0.5735	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-865.2421	(H17)
Solar input	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963	(63)
											Solar input (sum of months) = Sum(63)m =	-865.2421	(63)
Output from w/h													
	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)
											Total per year (kWh/year) = Sum(64)m =	849.7380	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	10.6334	0.4600	0.0000	0.7700	19.0577	(74)
East	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(76)
South	4.3100	46.7521	0.4600	0.0000	0.7700	71.3718	(78)
West	0.7200	19.6403	0.4600	0.0000	0.7700	5.0087	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	155.5904	263.2159	358.0944	444.7776	502.4434	501.5545	482.3456	438.3274	387.6537	290.0901	185.9644	133.4461	(83)
Total gains	773.5919	876.2181	946.8805	996.1008	1015.3269	980.2535	941.2850	906.3842	877.4794	817.6031	755.2474	734.4099	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6355	35.7599	35.8827	36.4707	36.5828	37.1142	37.1142	37.2143	36.9077	36.5828	36.3566	36.1231	
alpha	3.3757	3.3840	3.3922	3.4314	3.4389	3.4743	3.4743	3.4810	3.4605	3.4389	3.4238	3.4082	
util living area													
	0.9781	0.9656	0.9440	0.8997	0.8174	0.6773	0.5283	0.5635	0.7579	0.9096	0.9653	0.9814	(86)
MIT	19.2921	19.5088	19.8313	20.2431	20.6028	20.8591	20.9557	20.9437	20.7773	20.3199	19.7408	19.2595	(87)
Th 2	19.8289	19.8325	19.8360	19.8525	19.8556	19.8701	19.8701	19.8727	19.8645	19.8556	19.8493	19.8428	(88)
util rest of house													
	0.9731	0.9578	0.9308	0.8746	0.7688	0.5903	0.4077	0.4444	0.6819	0.8819	0.9561	0.9771	(89)
MIT 2	17.5944	17.9083	18.3721	18.9614	19.4443	19.7602	19.8484	19.8430	19.6723	19.0800	18.2576	17.5560	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8526	18.1518	18.5940	19.1564	19.6206	19.9274	20.0169	20.0104	19.8404	19.2686	18.4833	17.8152	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7026	18.0018	18.4440	19.0064	19.4706	19.7774	19.8669	19.8604	19.6904	19.1186	18.3333	17.6652	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9597	0.9407	0.9098	0.8514	0.7495	0.5823	0.4073	0.4430	0.6684	0.8588	0.9389	0.9651	(94)
Useful gains	742.4384	824.2328	861.4337	848.0820	760.9945	570.8089	383.4147	401.5335	586.4672	702.1978	709.1077	708.7896	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1687.1449	1643.5383	1493.1797	1243.0760	952.8409	625.7694	394.8557	417.1245	679.4706	1044.5713	1386.0139	1672.1364	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	702.8616	550.5733	470.0190	284.3956	142.7337	0.0000	0.0000	0.0000	0.0000	254.7259	487.3725	716.7300	(98)

Space heating 3609.4117 (98)
Space heating per m2 (98) / (4) = 37.7120 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3988.3002 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	702.8616	550.5733	470.0190	284.3956	142.7337	0.0000	0.0000	0.0000	0.0000	254.7259	487.3725	716.7300	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	776.6427	608.3683	519.3580	314.2493	157.7168	0.0000	0.0000	0.0000	0.0000	281.4651	538.5331	791.9668	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)

Efficiency of water heater 87.3000 (216)

(217)m 89.9225	89.9466	89.9827	90.0566	90.1494	87.3000	87.3000	87.3000	87.3000	89.6320	89.8203	89.9348	(217)

Fuel for water heating, kWh/month

166.0256	123.4545	97.1510	48.9960	18.7951	2.1281	0.0000	28.5666	54.4449	102.0449	141.1727	164.9196	(219)

Water heating fuel used 947.6990 (219)
Annual totals kWh/year
Space heating fuel - main system 3988.3002 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 3749.8392 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3988.3002	3.4800	138.7928	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.6990	3.4800	32.9799	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			135.3183	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.4039 (257)
SAP value 94.3655
SAP rating (Section 12) 94 (258)
SAP band A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3988.3002	0.2160	861.4728	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.6990	0.2160	204.7030	(264)
Space and water heating			1066.1758	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			450.5588	(272)
CO2 emissions per m2			4.7100	(273)
EI value			95.7093	
EI rating			96	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4122	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4122	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4328	0.4122	0.4122	0.3813	0.3813	0.3400	0.3503	0.3297	0.3400	0.3607	0.3607	0.3916	(22b)
Effective ac	0.5937	0.5849	0.5849	0.5727	0.5727	0.5578	0.5614	0.5544	0.5578	0.5650	0.5650	0.5767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.4688	47.7579	47.7579	46.7566	46.7566	45.5430	45.8334	45.2612	45.5430	46.1325	46.1325	47.0817	(38)
Heat transfer coeff	122.2534	121.5426	121.5426	120.5413	120.5413	119.3276	119.6180	119.0459	119.3276	119.9171	119.9171	120.8664	(39)
Average = Sum(39)m / 12 =												120.3701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2699	1.2699	1.2594	1.2594	1.2468	1.2498	1.2438	1.2468	1.2529	1.2529	1.2628	(40)
HLP (average)												1.2577	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2393	(H8)
Utilisation factor												0.5538	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.2325	(H14)
Volume ratio Veff/V												0.7635	(H15)
Solar storage volume factor												0.9460	(H16)
Solar input												-882.3194	(H17)
Solar input	-27.1574	-40.8174	-68.7417	-95.0221	-114.4386	-120.4417	-117.5496	-104.9725	-81.9314	-55.7364	-33.0105	-22.5000	(63)
											Solar input (sum of months) = Sum(63)m =	-882.3194	(63)
Output from w/h													
	147.2273	112.0942	89.9842	44.6672	20.5678	0.0000	0.0000	20.0408	43.9775	89.2518	123.5519	146.8163	(64)
											Total per year (kWh/year) = Sum(64)m =	838.1790	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.0600	11.9814	0.4600	0.0000	0.7700	21.4738	(74)
East	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(76)
South	4.3100	50.9848	0.4600	0.0000	0.7700	77.8335	(78)
West	0.7200	22.3313	0.4600	0.0000	0.7700	5.6950	(80)
South	3.3300	50.9848	0.4600	0.0000	0.7700	60.1359	(78)

Solar gains	170.8332	260.0819	350.4714	451.5532	500.1267	535.7859	509.0778	470.6161	412.1760	306.2298	209.1605	145.1308	(83)
Total gains	788.8347	873.0841	939.2574	1002.8764	1013.0103	1014.4848	968.0173	938.6728	902.0018	833.7428	778.4435	746.0945	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6931	36.9077	36.9077	37.2143	37.2143	37.5928	37.5015	37.6817	37.5928	37.4080	37.4080	37.1142	
alpha	3.4462	3.4605	3.4605	3.4810	3.4810	3.5062	3.5001	3.5121	3.5062	3.4939	3.4939	3.4743	
util living area													
	0.9730	0.9606	0.9336	0.8734	0.7573	0.5467	0.3747	0.3955	0.6661	0.8777	0.9537	0.9768	(86)
MIT	19.4935	19.6746	20.0043	20.4057	20.7464	20.9457	20.9896	20.9875	20.8822	20.4906	19.9482	19.4669	(87)
Th 2	19.8586	19.8645	19.8645	19.8727	19.8727	19.8828	19.8804	19.8851	19.8828	19.8779	19.8779	19.8701	(88)
util rest of house													
	0.9666	0.9515	0.9176	0.8414	0.6932	0.4403	0.2434	0.2626	0.5698	0.8399	0.9412	0.9713	(89)
MIT 2	17.9045	18.1677	18.6372	19.1977	19.6350	19.8514	19.8779	19.8819	19.7980	19.3262	18.5729	17.8740	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.1463	18.3969	18.8452	19.3815	19.8041	20.0179	20.0470	20.0501	19.9630	19.5033	18.7821	18.1163	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9963	18.2469	18.6952	19.2315	19.6541	19.8679	19.8970	19.9001	19.8130	19.3533	18.6321	17.9663	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9518	0.9337	0.8959	0.8191	0.6790	0.4388	0.2454	0.2645	0.5631	0.8178	0.9220	0.9579	(94)
Useful gains	750.8409	815.1734	841.5082	821.4934	687.8725	445.1716	237.5356	248.2390	507.8827	681.8274	717.7544	714.6628	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1576.6128	1537.1410	1372.8443	1124.8300	802.0956	461.5430	238.8811	250.0034	550.4533	929.7538	1274.9691	1555.1015	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	614.3743	485.1622	395.3141	218.4023	84.9820	0.0000	0.0000	0.0000	0.0000	184.4573	401.1947	625.2864	(98)

Space heating 3009.1733 (98)
Space heating per m2 (98) / (4) = 31.4405 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3325.0534 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	614.3743	485.1622	395.3141	218.4023	84.9820	0.0000	0.0000	0.0000	0.0000	184.4573	401.1947	625.2864	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	678.8666	536.0909	436.8111	241.3286	93.9028	0.0000	0.0000	0.0000	0.0000	203.8202	443.3090	690.9242	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	147.2273	112.0942	89.9842	44.6672	20.5678	0.0000	0.0000	20.0408	43.9775	89.2518	123.5519	146.8163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8632	89.8817	89.8891	89.9402	89.8582	87.3000	87.3000	87.3000	87.3000	89.4311	89.7256	89.8736	(217)
Fuel for water heating, kWh/month	163.8349	124.7131	100.1058	49.6632	22.8892	0.0000	0.0000	22.9562	50.3751	99.7995	137.6997	163.3587	(219)

Water heating fuel used 935.3955 (219)
Annual totals kWh/year
Space heating fuel - main system 3325.0534 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596 -1824.1596 (233)
Total delivered energy for all uses 2977.3686 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3325.0534	3.9200	130.3421	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	935.3955	3.9200	36.6675	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	416.0794	16.9600	70.5671	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			37.3992	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3325.0534	0.2160	718.2115	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.3955	0.2160	202.0454	(264)
Space and water heating			920.2570	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1824.1596		0.5190	-946.7389 (269)
Total kg/year				254.3383 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3325.0534	1.2200	4056.5651	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	935.3955	1.2200	1141.1825	(264)
Space and water heating			5197.7476	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1258.6912	(272)
Primary energy kWh/m2/year			13.1511	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.78 (37)
Summer heat loss coefficient		400.37 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	5.0600	81.1852	0.4600	0.0000	0.9000	170.0700
East	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
South	4.3100	112.2060	0.4600	0.0000	0.9000	200.2137
West	0.7200	117.5071	0.4600	0.0000	0.9000	35.0265
South	3.3300	112.2060	0.4600	0.0000	0.9000	154.6894
total:						595.0261

	Jun	Jul	Aug	
Solar gains	626	595	550	(P4)
Internal gains	476	456	465	
Total summer gains	1102	1051	1015	(P5)
Summer gain/loss ratio	2.75	2.63	2.54	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.57	21.34	21.15	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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DWELLING AS DESIGNED

Detached House, total floor area 132 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.07 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.96 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03: OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.68 m², No overhang
Windows facing East: 9.37 m², No overhang
Windows facing South: 0.72 m², No overhang
Windows facing South West: 1.03 m², No overhang
Windows facing West: 6.74 m², No overhang
Windows facing North West: 1.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.033 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1469	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3974	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3974	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5067	0.4968	0.4869	0.4372	0.4272	0.3776	0.3776	0.3676	0.3974	0.4272	0.4471	0.4670	(22b)
Effective ac	0.6284	0.6234	0.6185	0.5956	0.5913	0.5713	0.5713	0.5676	0.5790	0.5913	0.6000	0.6090	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.5634	70.0035	69.4548	66.8773	66.3951	64.1502	64.1502	63.7345	65.0149	66.3951	67.3707	68.3905	(38)
Heat transfer coeff	172.6448	172.0849	171.5362	168.9587	168.4765	166.2316	166.2316	165.8159	167.0963	168.4765	169.4520	170.4719	(39)
Average = Sum(39)m / 12 =												168.9564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3088	1.3046	1.3004	1.2809	1.2772	1.2602	1.2602	1.2570	1.2667	1.2772	1.2846	1.2923	(40)
HLP (average)												1.2808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998 (42)
Average daily hot water use (litres/day)	103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
								Total per year (kWh/year) = Sum(64)m =				2161.6685	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	520.8736	518.5965	501.3431	473.1974	444.0352	416.3627	398.6509	405.2388	419.9256	448.3067	480.9607	506.0135	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	691.3322	843.8789	1027.5753	1242.3080	1398.6449	1401.3737	1333.0523	1197.9709	1031.0265	830.8190	691.7730	647.4403	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7071	34.8200	34.9314	35.4643	35.5658	36.0461	36.0461	36.1365	35.8596	35.5658	35.3610	35.1495	
alpha	3.3138	3.3213	3.3288	3.3643	3.3711	3.4031	3.4031	3.4091	3.3906	3.3711	3.3574	3.3433	
util living area													
	0.9933	0.9865	0.9684	0.9172	0.8129	0.6573	0.5141	0.5792	0.8133	0.9558	0.9884	0.9946	(86)
MIT	18.9301	19.1717	19.5909	20.1413	20.5918	20.8639	20.9561	20.9343	20.7007	20.0902	19.4154	18.8996	(87)
Th 2	19.8339	19.8373	19.8405	19.8559	19.8587	19.8722	19.8722	19.8746	19.8670	19.8587	19.8529	19.8468	(88)
util rest of house													
	0.9917	0.9832	0.9604	0.8957	0.7645	0.5711	0.3964	0.4595	0.7455	0.9403	0.9851	0.9933	(89)
MIT 2	17.0785	17.4321	18.0405	18.8299	19.4341	19.7659	19.8504	19.8388	19.5950	18.7757	17.7987	17.0417	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.2997	17.6400	18.2257	18.9866	19.5724	19.8971	19.9825	19.9696	19.7271	18.9328	17.9919	17.2637	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1497	17.4900	18.0757	18.8366	19.4224	19.7471	19.8325	19.8196	19.5771	18.7828	17.8419	17.1137	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9855	0.9729	0.9429	0.8709	0.7426	0.5605	0.3920	0.4531	0.7242	0.9191	0.9756	0.9881	(94)
Useful gains	681.2774	821.0036	968.8504	1081.9347	1038.5955	785.4537	522.5121	542.8150	746.7169	763.5918	674.8637	639.7648	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	2218.4405	2166.5406	1985.6544	1678.8700	1301.0403	855.6038	537.3498	567.0306	915.2060	1378.6035	1820.2313	2201.4209 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	1143.6494	904.2008	756.5022	429.7934	195.2589	0.0000	0.0000	0.0000	0.0000	457.5686	824.6646	1161.8721 (98)
Space heating												5873.5102 (98)
Space heating per m2											(98) / (4) =	44.5266 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	6497.2458 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1143.6494	904.2008	756.5022	429.7934	195.2589	0.0000	0.0000	0.0000	0.0000	457.5686	824.6646	1161.8721	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1265.0989	1000.2222	836.8387	475.4352	215.9944	0.0000	0.0000	0.0000	0.0000	506.1600	912.2397	1285.2568	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.5267	88.3540	87.9544	86.9975	85.0399	79.7000	79.7000	79.7000	79.7000	87.0580	88.1433	88.5890	(217)
Fuel for water heating, kWh/month													
	241.7303	213.3176	224.6678	203.0817	203.1995	193.1253	184.8999	203.6870	203.5762	210.4636	220.4656	235.5715	(219)
Water heating fuel used												2537.7859	(219)
Annual totals kWh/year													
Space heating fuel - main system												6497.2458	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Total delivered energy for all uses												9585.3561	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6497.2458	0.2160	1403.4051	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2537.7859	0.2160	548.1618	(264)
Space and water heating			1951.5668	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Total CO2, kg/year			2237.1852	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.9600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.9600	ZC1
Total Floor Area	TFA	131.9100	
Assumed number of occupants	N	2.8998	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.4773	ZC2
CO2 emissions from cooking, equation (L16)		1.4297	ZC3
Total CO2 emissions		31.8670	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.8670	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500	(1b)	x 2.5400	(2b) =	169.0370	(1b) - (3b)
First floor	65.3600	(1c)	x 2.6200	(2c) =	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1176	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3676	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3676	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4686	0.4594	0.4502	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6055	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5675	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			26.5700	1.3258	35.2254			(27)
GF B&B J150 P/A=0.50			66.5500	0.1300	8.6515			(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.1800	25.0884			(29a)
Plane Ceiling	65.3600		65.3600	0.1300	8.4968			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.3015			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.7826	(36)
Total fabric heat loss					(33) + (36) =		96.0841	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.4766	67.9977	67.5284	65.3240	64.9116	62.9917	62.9917	62.6361	63.7312	64.9116	65.7460	66.6182	(38)
Heat transfer coeff	164.5606	164.0818	163.6125	161.4081	160.9957	159.0757	159.0757	158.7202	159.8153	160.9957	161.8300	162.7023	(39)
Average = Sum(39)m / 12 =												161.4062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2475	1.2439	1.2403	1.2236	1.2205	1.2059	1.2059	1.2032	1.2115	1.2205	1.2268	1.2334	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998	(42)
Average daily hot water use (litres/day)	103.0697	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day): 1.5003 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8102 (55)
Total storage loss
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (56)
If cylinder contains dedicated solar storage
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
216.5120 190.7473 200.1215 179.1111 175.3169 156.3560 149.8816 164.8549 164.6854 185.7418 196.7608 211.2068 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
216.5120 190.7473 200.1215 179.1111 175.3169 156.3560 149.8816 164.8549 164.6854 185.7418 196.7608 211.2068 (64)
Total per year (kWh/year) = Sum(64)m = 2191.2959 (64)
Heat gains from water heating, kWh/month
94.6068 83.8514 89.1570 81.4414 80.9094 73.8754 72.4522 77.4308 76.6449 84.3757 87.3100 92.8428 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	127.1597	124.7788	119.8346	113.1131	108.7492	102.6047	97.3820	104.0737	106.4513	113.4082	121.2638	124.7888	(72)
Total internal gains													
	523.5793	521.3022	504.0488	475.9032	446.7409	419.0684	401.3566	407.9445	422.6313	451.0124	483.6664	508.7193	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.6300	0.7000	0.7700	24.9577	(74)
East	9.3700	19.6403	0.6300	0.7000	0.7700	56.2417	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
Southwest	1.0300	36.7938	0.6300	0.7000	0.7700	11.5820	(79)
West	6.7400	19.6403	0.6300	0.7000	0.7700	40.4556	(80)
Northwest	1.0300	11.2829	0.6300	0.7000	0.7700	3.5517	(81)

Solar gains	147.0762	280.6621	454.0469	663.6086	823.6621	849.8932	806.2259	683.9899	527.2738	330.0416	181.8944	122.0267	(83)
Total gains	670.6555	801.9643	958.0957	1139.5118	1270.4030	1268.9616	1207.5825	1091.9344	949.9051	781.0540	665.5608	630.7460	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6659	55.8283	55.9885	56.7531	56.8985	57.5852	57.5852	57.7142	57.3188	56.8985	56.6052	56.3017	
alpha	4.7111	4.7219	4.7326	4.7835	4.7932	4.8390	4.8390	4.8476	4.8213	4.7932	4.7737	4.7534	
util living area													
	0.9990	0.9975	0.9918	0.9669	0.8877	0.7268	0.5615	0.6339	0.8837	0.9860	0.9979	0.9993	(86)
MIT	19.5462	19.7108	20.0039	20.4019	20.7403	20.9325	20.9845	20.9732	20.8146	20.3644	19.8869	19.5251	(87)
Th 2	19.8822	19.8850	19.8879	19.9011	19.9036	19.9152	19.9152	19.9174	19.9108	19.9036	19.8986	19.8933	(88)
util rest of house													
	0.9987	0.9966	0.9887	0.9535	0.8431	0.6319	0.4322	0.5014	0.8187	0.9784	0.9970	0.9990	(89)
MIT 2	17.9411	18.1836	18.6125	19.1920	19.6465	19.8702	19.9096	19.9063	19.7551	19.1483	18.4510	17.9179	(90)
Living area fraction									fLA = Living area / (4) =			0.1195	(91)
MIT	18.1329	18.3661	18.7787	19.3366	19.7772	19.9971	20.0381	20.0338	19.8817	19.2936	18.6225	18.1099	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1329	18.3661	18.7787	19.3366	19.7772	19.9971	20.0381	20.0338	19.8817	19.2936	18.6225	18.1099	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9947	0.9840	0.9443	0.8369	0.6398	0.4475	0.5166	0.8166	0.9721	0.9953	0.9983	(94)
Useful gains	669.1593	797.6855	942.8042	1076.0654	1063.1920	811.8601	540.3716	564.1179	775.6629	759.2349	662.4221	629.6970	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2276.3529	2209.5360	2008.9508	1684.5490	1300.3951	858.5513	546.9126	576.7498	924.0027	1399.6282	1864.6943	2263.1709	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1195.7520	948.7635	793.2131	438.1082	176.4791	0.0000	0.0000	0.0000	0.0000	476.4526	865.6359	1215.3045	(98)
Space heating												6109.7090	(98)
Space heating per m2											(98) / (4) =	46.3173	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6534.4481	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1195.7520	948.7635	793.2131	438.1082	176.4791	0.0000	0.0000	0.0000	0.0000	476.4526	865.6359	1215.3045	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1278.8792	1014.7203	848.3563	468.5649	188.7477	0.0000	0.0000	0.0000	0.0000	509.5750	925.8138	1299.7910	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.5120	190.7473	200.1215	179.1111	175.3169	156.3560	149.8816	164.8549	164.6854	185.7418	196.7608	211.2068	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.6771	88.5133	88.1196	87.1105	84.8315	79.8000	79.8000	79.8000	79.8000	87.2197	88.3071	88.7383	(217)
Fuel for water heating, kWh/month													
	244.1577	215.5013	227.1022	205.6136	206.6649	195.9348	187.8215	206.5850	206.3727	212.9586	222.8143	238.0108	(219)
Water heating fuel used												2569.5374	(219)
Annual totals kWh/year													
Space heating fuel - main system												6534.4481	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Total delivered energy for all uses												9654.3100	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6534.4481	0.2160	1411.4408	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.5374	0.2160	555.0201	(264)
Space and water heating			1966.4609	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Total CO2, kg/m2/year			2252.0793	(272)
Emissions per m2 for space and water heating			14.9076	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.8702	(272b)
Emissions per m2 for pumps and fans			0.2951	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9076 * 1.00) + 1.8702 + 0.2951, rounded to 2 d.p.			17.0700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1176	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3681	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3496	0.3496	0.3404	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5101	68.0300	67.5594	65.3490	64.9355	63.0103	63.0103	62.6538	63.7519	64.9355	65.7721	66.6467	(38)
Heat transfer coeff	170.5915	170.1114	169.6408	167.4304	167.0169	165.0917	165.0917	164.7352	165.8332	167.0169	167.8535	168.7281	(39)
Average = Sum(39)m / 12 =												167.4284	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2932	1.2896	1.2860	1.2693	1.2661	1.2515	1.2515	1.2488	1.2572	1.2661	1.2725	1.2791	(40)
HLP (average)												1.2693	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7285	31.2484	32.2456	28.1125	26.9746	23.2770	21.5696	24.7514	25.0470	29.1899	31.8630	34.6012	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	48.0222	46.5006	43.3408	39.0451	36.2561	32.3292	28.9914	33.2680	34.7875	39.2337	44.2542	46.5070	(72)
Total internal gains													
	441.4418	440.0240	424.5550	398.8351	371.2478	345.7929	329.9660	334.1388	347.9676	373.8379	403.6568	427.4375	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	611.9005	765.3064	950.7872	1167.9457	1325.8575	1330.8039	1264.3674	1126.8709	959.0684	756.3502	614.4691	568.8642	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.1248	35.2240	35.3217	35.7880	35.8766	36.2950	36.2950	36.3735	36.1327	35.8766	35.6978	35.5127	
alpha	3.3417	3.3483	3.3548	3.3859	3.3918	3.4197	3.4197	3.4249	3.4088	3.3918	3.3799	3.3675	
util living area													
	0.9954	0.9899	0.9743	0.9280	0.8292	0.6777	0.5343	0.6041	0.8361	0.9654	0.9919	0.9964	(86)
MIT	18.8813	19.1242	19.5469	20.1036	20.5678	20.8522	20.9514	20.9263	20.6733	20.0414	19.3613	18.8474	(87)
Th 2	19.8461	19.8490	19.8518	19.8650	19.8675	19.8790	19.8790	19.8811	19.8745	19.8675	19.8624	19.8572	(88)
util rest of house													
	0.9943	0.9874	0.9677	0.9088	0.7832	0.5921	0.4144	0.4829	0.7726	0.9529	0.9895	0.9955	(89)
MIT 2	17.9130	18.1568	18.5774	19.1281	19.5573	19.7991	19.8623	19.8531	19.6678	19.0799	18.4038	17.8872	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	18.0287	18.2724	18.6932	19.2447	19.6780	19.9249	19.9924	19.9813	19.7879	19.1948	18.5182	18.0019	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0287	18.2724	18.6932	19.2447	19.6780	19.9249	19.9924	19.9813	19.7879	19.1948	18.5182	18.0019	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9826	0.9588	0.8957	0.7742	0.5959	0.4273	0.4947	0.7667	0.9427	0.9854	0.9934	(94)
Useful gains	606.7886	751.9570	911.5889	1046.1293	1026.5010	793.0592	540.2563	557.4712	735.3279	713.0294	605.4769	565.1233	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2341.9911	2274.7915	2068.4637	1732.0092	1332.4626	879.0989	560.0650	589.9657	943.2480	1435.4726	1916.5899	2328.7730	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1290.9906	1023.3448	860.7149	493.8335	227.6354	0.0000	0.0000	0.0000	0.0000	537.4977	944.0014	1312.1554	(98)
Space heating												6690.1737	(98)
Space heating per m2											(98) / (4) =	50.7177	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1551.8619	1221.6785	1251.9873	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8023	0.8641	0.8239	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1245.0610	1055.6142	1031.5123	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1674.9000	1594.5213	1436.0873	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	309.4841	400.9469	301.0038	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1011.4348	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	77.3710	100.2367	75.2509	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												252.8587	(107)
Space cooling per m2												1.9169	(108)
Energy for space heating												50.7177	(99)
Energy for space cooling												1.9169	(108)
Total												52.6346	(109)
Dwelling Fabric Energy Efficiency (DFEE)												52.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1176	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3676	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3676	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4686	0.4594	0.4502	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6055	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5675	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			26.5700	1.3258	35.2254			(27)
GF B&B J150 P/A=0.50			66.5500	0.1300	8.6515			(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.1800	25.0884			(29a)
Plane Ceiling	65.3600		65.3600	0.1300	8.4968			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		82.3015			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.7826	(36)
Total fabric heat loss (33) + (36) =	96.0841	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.4766	67.9977	67.5284	65.3240	64.9116	62.9917	62.9917	62.6361	63.7312	64.9116	65.7460	66.6182	(38)
Heat transfer coeff	164.5606	164.0818	163.6125	161.4081	160.9957	159.0757	159.0757	158.7202	159.8153	160.9957	161.8300	162.7023	(39)
Average = Sum(39)m / 12 =												161.4062	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2475	1.2439	1.2403	1.2236	1.2205	1.2059	1.2059	1.2032	1.2115	1.2205	1.2268	1.2334	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998 (42)
Average daily hot water use (litres/day)	103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.7285	31.2484	32.2456	28.1125	26.9746	23.2770	21.5696	24.7514	25.0470	29.1899	31.8630	34.6012	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	144.9888	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9148	23.9055	19.4413	14.7183	11.0021	9.2884	10.0365	13.0458	17.5100	22.2330	25.9492	27.6629	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0081	303.1213	295.2762	278.5751	257.4929	237.6787	224.4415	221.3284	229.1734	245.8745	266.9567	286.7710	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	37.4989	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	48.0222	46.5006	43.3408	39.0451	36.2561	32.3292	28.9914	33.2680	34.7875	39.2337	44.2542	46.5070	(72)
Total internal gains													
	441.4418	440.0240	424.5550	398.8351	371.2478	345.7929	329.9660	334.1388	347.9676	373.8379	403.6568	427.4375	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.6300	0.7000	0.7700	24.9577	(74)
East	9.3700	19.6403	0.6300	0.7000	0.7700	56.2417	(76)
South	0.7200	46.7521	0.6300	0.7000	0.7700	10.2874	(78)
Southwest	1.0300	36.7938	0.6300	0.7000	0.7700	11.5820	(79)
West	6.7400	19.6403	0.6300	0.7000	0.7700	40.4556	(80)
Northwest	1.0300	11.2829	0.6300	0.7000	0.7700	3.5517	(81)

Solar gains	147.0762	280.6621	454.0469	663.6086	823.6621	849.8932	806.2259	683.9899	527.2738	330.0416	181.8944	122.0267	(83)
Total gains	588.5180	720.6861	878.6018	1062.4438	1194.9099	1195.6861	1136.1919	1018.1287	875.2413	703.8795	585.5511	549.4642	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6659	55.8283	55.9885	56.7531	56.8985	57.5852	57.5852	57.7142	57.3188	56.8985	56.6052	56.3017	
alpha	4.7111	4.7219	4.7326	4.7835	4.7932	4.8390	4.8390	4.8476	4.8213	4.7932	4.7737	4.7534	
util living area													
	0.9994	0.9984	0.9943	0.9745	0.9061	0.7561	0.5919	0.6699	0.9084	0.9908	0.9988	0.9996	(86)
MIT	19.4890	19.6545	19.9502	20.3553	20.7086	20.9196	20.9807	20.9661	20.7834	20.3133	19.8312	19.4682	(87)
Th 2	19.8822	19.8850	19.8879	19.9011	19.9036	19.9152	19.9152	19.9174	19.9108	19.9036	19.8986	19.8933	(88)
util rest of house													
	0.9992	0.9978	0.9920	0.9637	0.8660	0.6625	0.4580	0.5345	0.8518	0.9856	0.9983	0.9995	(89)
MIT 2	18.4998	18.6673	18.9641	19.3730	19.7027	19.8776	19.9103	19.9074	19.7818	19.3384	18.8548	18.4878	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	18.6180	18.7852	19.0819	19.4903	19.8228	20.0021	20.0382	20.0339	19.9015	19.4549	18.9714	18.6049	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6180	18.7852	19.0819	19.4903	19.8228	20.0021	20.0382	20.0339	19.9015	19.4549	18.9714	18.6049	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9970	0.9897	0.9584	0.8625	0.6709	0.4740	0.5503	0.8512	0.9825	0.9976	0.9992	(94)
Useful gains	587.8769	718.5340	869.5770	1018.2805	1030.5820	802.1496	538.5726	560.2748	744.9855	691.5742	584.1485	549.0381	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2356.1732	2278.3163	2058.5573	1709.3671	1307.7426	859.3491	546.9374	576.7781	927.1678	1425.5976	1921.1517	2343.7160	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1315.6125	1048.1737	884.6014	497.5824	206.2075	0.0000	0.0000	0.0000	0.0000	546.1134	962.6423	1335.2404	(98)
Space heating												6796.1735	(98)
Space heating per m2											(98) / (4) =	51.5213	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1495.3120	1177.1605	1206.2735	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8346	0.9015	0.8610	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1248.0497	1061.1549	1038.6077	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1516.9701	1444.7058	1308.9860	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	193.6227	285.3619	201.1615	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												680.1461	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	48.4057	71.3405	50.2904	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												170.0365	(107)
Space cooling per m2												1.2890	(108)
Energy for space heating												51.5213	(99)
Energy for space cooling												1.2890	(108)
Total												52.8103	(109)
Target Fabric Energy Efficiency (TFEE)												60.7	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1469	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3974	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3974	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4173	0.3974	0.3974	0.3676	0.3676	0.3279	0.3378	0.3180	0.3279	0.3478	0.3478	0.3776	(22b)
Effective ac	0.5871	0.5790	0.5790	0.5676	0.5676	0.5538	0.5571	0.5505	0.5538	0.5605	0.5605	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.9239	65.0149	65.0149	63.7345	63.7345	62.1825	62.5539	61.8222	62.1825	62.9363	62.9363	64.1502	(38)
Heat transfer coeff	168.0053	167.0963	167.0963	165.8159	165.8159	164.2639	164.6352	163.9036	164.2639	165.0177	165.0177	166.2316	(39)
Average = Sum(39)m / 12 =												165.5969	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2736	1.2667	1.2667	1.2570	1.2570	1.2453	1.2481	1.2425	1.2453	1.2510	1.2510	1.2602	(40)
HLP (average)												1.2554	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
									Total per year (kWh/year) = Sum(64)m =			2161.6685	(64)
RHI water heating demand												2162	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	755.8084	750.5507	722.7369	679.2808	634.1605	594.1583	571.0488	580.6173	605.8644	649.5559	698.1680	735.5506	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	11.9814	0.4600	0.0000	0.7700	32.5926	(74)
East	5.5700	22.3313	0.4600	0.0000	0.7700	44.0573	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
Southwest	1.0300	40.4699	0.4600	0.0000	0.7700	14.7645	(79)
West	6.7400	22.3313	0.4600	0.0000	0.7700	53.3117	(80)
Northwest	1.0300	12.9236	0.4600	0.0000	0.7700	4.7149	(81)
East	3.8000	22.3313	0.4600	0.0000	0.7700	30.0571	(76)

Solar gains	192.5004	331.1868	530.1346	798.6728	965.1248	1065.2137	999.7862	868.0073	667.4948	416.1476	244.0465	158.0731	(83)
Total gains	948.3087	1081.7375	1252.8715	1477.9536	1599.2854	1659.3719	1570.8349	1448.6246	1273.3593	1065.7035	942.2145	893.6237	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6655	35.8596	35.8596	36.1365	36.1365	36.4779	36.3956	36.5581	36.4779	36.3112	36.3112	36.0461	
alpha	3.3777	3.3906	3.3906	3.4091	3.4091	3.4319	3.4264	3.4372	3.4319	3.4207	3.4207	3.4031	
util living area													
	0.9803	0.9686	0.9357	0.8496	0.6963	0.4715	0.3202	0.3550	0.6520	0.8930	0.9655	0.9833	(86)
MIT	19.3446	19.5477	19.9526	20.4418	20.7968	20.9628	20.9930	20.9901	20.8827	20.4270	19.8192	19.3176	(87)
Th 2	19.8615	19.8670	19.8670	19.8746	19.8746	19.8840	19.8817	19.8861	19.8840	19.8794	19.8794	19.8722	(88)
util rest of house													
	0.9756	0.9613	0.9204	0.8146	0.6295	0.3754	0.2069	0.2348	0.5567	0.8589	0.9559	0.9794	(89)
MIT 2	17.6971	17.9928	18.5701	19.2456	19.6885	19.8629	19.8801	19.8836	19.7991	19.2483	18.3961	17.6649	(90)
Living area fraction									fLA = Living area / (4) =			0.1195	(91)
MIT	17.8939	18.1786	18.7352	19.3885	19.8209	19.9944	20.0130	20.0158	19.9286	19.3891	18.5662	17.8623	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7439	18.0286	18.5852	19.2385	19.6709	19.8444	19.8630	19.8658	19.7786	19.2391	18.4162	17.7123	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9443	0.8973	0.7909	0.6161	0.3719	0.2050	0.2325	0.5467	0.8339	0.9379	0.9677	(94)
Useful gains	912.8291	1021.5326	1124.2407	1168.8675	985.3117	617.0846	322.0428	336.8281	696.1345	888.7034	883.6572	864.7944	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	2124.2495	2076.7661	1869.0120	1548.4772	1106.1478	631.4883	323.1830	338.5856	752.0938	1260.5865	1718.8506	2096.5678	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	901.2968	709.1169	554.1099	273.3190	89.9021	0.0000	0.0000	0.0000	0.0000	276.6810	601.3392	916.4394	(98)
Space heating												4322.2043	(98)
RHI space heating demand												4322	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1469	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3974	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3974	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5067	0.4968	0.4869	0.4372	0.4272	0.3776	0.3776	0.3676	0.3974	0.4272	0.4471	0.4670	(22b)
Effective ac	0.6284	0.6234	0.6185	0.5956	0.5913	0.5713	0.5713	0.5676	0.5790	0.5913	0.6000	0.6090	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.5634	70.0035	69.4548	66.8773	66.3951	64.1502	64.1502	63.7345	65.0149	66.3951	67.3707	68.3905	(38)
Heat transfer coeff	172.6448	172.0849	171.5362	168.9587	168.4765	166.2316	166.2316	165.8159	167.0963	168.4765	169.4520	170.4719	(39)
Average = Sum(39)m / 12 =												168.9564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3088	1.3046	1.3004	1.2809	1.2772	1.2602	1.2602	1.2570	1.2667	1.2772	1.2846	1.2923	(40)
HLP (average)												1.2808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998 (42)
Average daily hot water use (litres/day)	103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
									Total per year (kWh/year) = Sum(64)m =			2161.6685	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	755.8084	750.5507	722.7369	679.2808	634.1605	594.1583	571.0488	580.6173	605.8644	649.5559	698.1680	735.5506	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	926.2670	1075.8330	1248.9691	1448.3914	1588.7702	1579.1693	1505.4501	1373.3494	1216.9653	1032.0683	908.9803	876.9774	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7071	34.8200	34.9314	35.4643	35.5658	36.0461	36.0461	36.1365	35.8596	35.5658	35.3610	35.1495	
alpha	3.3138	3.3213	3.3288	3.3643	3.3711	3.4031	3.4031	3.4091	3.3906	3.3711	3.3574	3.3433	
util living area													
	0.9841	0.9731	0.9471	0.8824	0.7658	0.6042	0.4635	0.5194	0.7510	0.9234	0.9745	0.9867	(86)
MIT	19.1420	19.3740	19.7682	20.2730	20.6675	20.8953	20.9679	20.9529	20.7724	20.2411	19.6069	19.1090	(87)
Th 2	19.8339	19.8373	19.8405	19.8559	19.8587	19.8722	19.8722	19.8746	19.8670	19.8587	19.8529	19.8468	(88)
util rest of house													
	0.9805	0.9670	0.9347	0.8550	0.7125	0.5190	0.3540	0.4066	0.6753	0.8994	0.9676	0.9836	(89)
MIT 2	17.3858	17.7231	18.2902	19.0044	19.5214	19.7928	19.8568	19.8499	19.6692	18.9802	18.0738	17.3458	(90)
Living area fraction									fLA = Living area / (4) =			0.1195	(91)
MIT	17.5956	17.9203	18.4668	19.1559	19.6584	19.9245	19.9895	19.9817	19.8010	19.1308	18.2569	17.5565	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4456	17.7703	18.3168	19.0059	19.5084	19.7745	19.8395	19.8317	19.6510	18.9808	18.1069	17.4065	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9690	0.9511	0.9127	0.8298	0.6938	0.5110	0.3507	0.4020	0.6586	0.8746	0.9520	0.9735	(94)
Useful gains	897.5311	1023.2316	1139.9226	1201.8200	1102.3381	806.9540	527.9397	552.1507	801.4395	902.6424	865.3582	853.6952	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	2269.5221	2214.7909	2027.0061	1707.4874	1315.5278	860.1649	538.5149	569.0287	927.5581	1411.9730	1865.1485	2251.3366 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	1020.7614	800.7278	659.9902	364.0805	158.6131	0.0000	0.0000	0.0000	0.0000	378.9419	719.8490	1039.8452 (98)
Space heating												5142.8091 (98)
Space heating per m2											(98) / (4) =	38.9873 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	5688.9481 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1020.7614	800.7278	659.9902	364.0805	158.6131	0.0000	0.0000	0.0000	0.0000	378.9419	719.8490	1039.8452	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1129.1608	885.7609	730.0776	402.7439	175.4569	0.0000	0.0000	0.0000	0.0000	419.1836	796.2932	1150.2712	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3444	88.1453	87.6874	86.6014	84.4860	79.7000	79.7000	79.7000	79.7000	86.6102	87.8917	88.4159	(217)
Fuel for water heating, kWh/month													
	242.2288	213.8226	225.3518	204.0105	204.5317	193.1253	184.8999	203.6870	203.5762	211.5518	221.0966	236.0327	(219)
Water heating fuel used												2543.9150	(219)
Annual totals kWh/year													
Space heating fuel - main system												5688.9481	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Total delivered energy for all uses												8783.1876	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5688.9481	3.4800	197.9754	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2543.9150	3.4800	88.5282	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	475.3244	13.1900	62.6953	(250)
Additional standing charges			120.0000	(251)
Total energy cost			479.0914	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1374 (257)
SAP value		84.1332
SAP rating (Section 12)		84 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5688.9481	0.2160	1228.8128	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2543.9150	0.2160	549.4857	(264)
Space and water heating			1778.2984	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Total kg/year			2063.9168	(272)
CO2 emissions per m2			15.6500	(273)
EI value			84.3669	
EI rating			84	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8475 = 4.106, stars = 4
Water heating environmental impact	0.216 / 0.8475 = 0.2549, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.1469	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.3974	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3974	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4173	0.3974	0.3974	0.3676	0.3676	0.3279	0.3378	0.3180	0.3279	0.3478	0.3478	0.3776	(22b)
Effective ac	0.5871	0.5790	0.5790	0.5676	0.5676	0.5538	0.5571	0.5505	0.5538	0.5605	0.5605	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.9239	65.0149	65.0149	63.7345	63.7345	62.1825	62.5539	61.8222	62.1825	62.9363	62.9363	64.1502	(38)
Heat transfer coeff	168.0053	167.0963	167.0963	165.8159	165.8159	164.2639	164.6352	163.9036	164.2639	165.0177	165.0177	166.2316	(39)
Average = Sum(39)m / 12 =												165.5969	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2736	1.2667	1.2667	1.2570	1.2570	1.2453	1.2481	1.2425	1.2453	1.2510	1.2510	1.2602	(40)
HLP (average)												1.2554	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998 (42)
Average daily hot water use (litres/day)	103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
								Total per year (kWh/year) = Sum(64)m =				2161.6685	(64)
Heat gains from water heating, kWh/month													
	92.5938	82.0331	87.1439	79.4933	78.8964	71.9273	70.4392	75.4178	74.6968	82.3627	85.3619	90.8298	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	124.4540	122.0731	117.1289	110.4074	106.0435	99.8990	94.6763	101.3680	103.7456	110.7025	118.5581	122.0831	(72)
Total internal gains													
	755.8084	750.5507	722.7369	679.2808	634.1605	594.1583	571.0488	580.6173	605.8644	649.5559	698.1680	735.5506	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	11.9814	0.4600	0.0000	0.7700	32.5926	(74)
East	5.5700	22.3313	0.4600	0.0000	0.7700	44.0573	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
Southwest	1.0300	40.4699	0.4600	0.0000	0.7700	14.7645	(79)
West	6.7400	22.3313	0.4600	0.0000	0.7700	53.3117	(80)
Northwest	1.0300	12.9236	0.4600	0.0000	0.7700	4.7149	(81)
East	3.8000	22.3313	0.4600	0.0000	0.7700	30.0571	(76)

Solar gains	192.5004	331.1868	530.1346	798.6728	965.1248	1065.2137	999.7862	868.0073	667.4948	416.1476	244.0465	158.0731	(83)
Total gains	948.3087	1081.7375	1252.8715	1477.9536	1599.2854	1659.3719	1570.8349	1448.6246	1273.3593	1065.7035	942.2145	893.6237	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6655	35.8596	35.8596	36.1365	36.1365	36.4779	36.3956	36.5581	36.4779	36.3112	36.3112	36.0461	
alpha	3.3777	3.3906	3.3906	3.4091	3.4091	3.4319	3.4264	3.4372	3.4319	3.4207	3.4207	3.4031	
util living area													
	0.9803	0.9686	0.9357	0.8496	0.6963	0.4715	0.3202	0.3550	0.6520	0.8930	0.9655	0.9833	(86)
MIT	19.3446	19.5477	19.9526	20.4418	20.7968	20.9628	20.9930	20.9901	20.8827	20.4270	19.8192	19.3176	(87)
Th 2	19.8615	19.8670	19.8670	19.8746	19.8746	19.8840	19.8817	19.8861	19.8840	19.8794	19.8794	19.8722	(88)
util rest of house													
	0.9756	0.9613	0.9204	0.8146	0.6295	0.3754	0.2069	0.2348	0.5567	0.8589	0.9559	0.9794	(89)
MIT 2	17.6971	17.9928	18.5701	19.2456	19.6885	19.8629	19.8801	19.8836	19.7991	19.2483	18.3961	17.6649	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.8939	18.1786	18.7352	19.3885	19.8209	19.9944	20.0130	20.0158	19.9286	19.3891	18.5662	17.8623	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7439	18.0286	18.5852	19.2385	19.6709	19.8444	19.8630	19.8658	19.7786	19.2391	18.4162	17.7123	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9443	0.8973	0.7909	0.6161	0.3719	0.2050	0.2325	0.5467	0.8339	0.9379	0.9677	(94)
Useful gains	912.8291	1021.5326	1124.2407	1168.8675	985.3117	617.0846	322.0428	336.8281	696.1345	888.7034	883.6572	864.7944	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	2124.2495	2076.7661	1869.0120	1548.4772	1106.1478	631.4883	323.1830	338.5856	752.0938	1260.5865	1718.8506	2096.5678 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	901.2968	709.1169	554.1099	273.3190	89.9021	0.0000	0.0000	0.0000	0.0000	276.6810	601.3392	916.4394 (98)
Space heating												4322.2043 (98)
Space heating per m2											(98) / (4) =	32.7663 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4781.1995 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	901.2968	709.1169	554.1099	273.3190	89.9021	0.0000	0.0000	0.0000	0.0000	276.6810	601.3392	916.4394	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	997.0098	784.4214	612.9534	302.3440	99.4492	0.0000	0.0000	0.0000	0.0000	306.0630	665.1983	1013.7604	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9957	188.4745	197.6052	176.6759	172.8006	153.9209	147.3653	162.3386	162.2503	183.2255	194.3256	208.6905	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1298	87.9215	87.3184	85.8736	83.0646	79.7000	79.7000	79.7000	79.7000	85.8103	87.5300	88.2036	(217)
Fuel for water heating, kWh/month													
	242.8188	214.3669	226.3042	205.7396	208.0315	193.1253	184.8999	203.6870	203.5762	213.5238	222.0103	236.6009	(219)
Water heating fuel used												2554.6845	(219)
Annual totals kWh/year													
Space heating fuel - main system												4781.1995	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Total delivered energy for all uses												7886.2084	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4781.1995	3.9200	187.4230	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2554.6845	3.9200	100.1436	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	475.3244	16.9600	80.6150	(250)
Additional standing charges			88.0000	(251)
Total energy cost			468.9017	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4781.1995	0.2160	1032.7391	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2554.6845	0.2160	551.8118	(264)
Space and water heating			1584.5509	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Total kg/year			1870.1693	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4781.1995	1.2200	5833.0634	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2554.6845	1.2200	3116.7150	(264)
Space and water heating			8949.7784	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	475.3244	3.0700	1459.2460	(268)
Primary energy kWh/year			10639.2744	(272)
Primary energy kWh/m2/year			80.6556	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 84

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 44	-261 kg (14.0%)
U Solar photovoltaic panels	+ 7.5	-£ 309	-947 kg (58.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.98 kg/m²	B 85	B 86
Solar photovoltaic panels	£309	7.18 kg/m²	A 93	A 93
Total Savings	£353	9.16 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£93	£102	-£8
Mains gas	£376	£323	£52
Space heating	£288	£289	-£1
Water heating	£100	£55	£45
Lighting	£81	£81	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£469	£116	£353
Total cost of uses	£469	£116	£353
Delivered energy	60 kWh/m²	36 kWh/m²	24 kWh/m²
Carbon dioxide emissions	1.9 tonnes	0.7 tonnes	1.2 tonnes
CO2 emissions per m²	14 kg/m²	5 kg/m²	9 kg/m²
Primary energy	81 kWh/m²	27 kWh/m²	54 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1469	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3974	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3974	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5067	0.4968	0.4869	0.4372	0.4272	0.3776	0.3776	0.3676	0.3974	0.4272	0.4471	0.4670	(22b)
Effective ac	0.6284	0.6234	0.6185	0.5956	0.5913	0.5713	0.5713	0.5676	0.5790	0.5913	0.6000	0.6090	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.5634	70.0035	69.4548	66.8773	66.3951	64.1502	64.1502	63.7345	65.0149	66.3951	67.3707	68.3905	(38)
Heat transfer coeff	172.6448	172.0849	171.5362	168.9587	168.4765	166.2316	166.2316	165.8159	167.0963	168.4765	169.4520	170.4719	(39)
Average = Sum(39)m / 12 =												168.9564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3088	1.3046	1.3004	1.2809	1.2772	1.2602	1.2602	1.2570	1.2667	1.2772	1.2846	1.2923	(40)
HLP (average)												1.2808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8998 (42)
Average daily hot water use (litres/day)		103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.1279	181.3681	188.3416	162.3083	152.1384	133.7001	126.4705	142.3743	149.2333	173.9619	186.7116	200.8226	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1183	(H8)
Utilisation factor												0.5911	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0697	(H14)
Volume ratio Veff/V												1.0624	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-942.5522	(H17)
Solar input	-27.3321	-45.6095	-77.6782	-104.1040	-128.6118	-126.4459	-124.7748	-109.0164	-85.3817	-58.3057	-32.4198	-22.8723	(63)
								Solar input (sum of months) = Sum(63)m =				-942.5522	(63)
Output from w/h													
	178.7957	135.7586	110.6634	58.2042	23.5266	7.2542	1.6956	33.3579	63.8516	115.6562	154.2917	177.9503	(64)
								Total per year (kWh/year) = Sum(64)m =				1061.0063	(64)
Heat gains from water heating, kWh/month													
	86.2995	76.3480	79.7331	67.9992	62.3667	55.7507	53.7233	59.4463	64.2833	74.9518	79.2706	84.5355	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	115.9939	113.6131	107.1681	94.4433	83.8262	77.4315	72.2088	79.9010	89.2823	100.7417	110.0981	113.6230	(72)
Total internal gains													
	747.3483	742.0906	712.7760	663.3168	611.9432	571.6908	548.5812	559.1503	591.4012	639.5951	689.7079	727.0905	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
East	5.5700	19.6403	0.4600	0.0000	0.7700	38.7482	(76)
South	0.7200	46.7521	0.4600	0.0000	0.7700	11.9229	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	6.7400	19.6403	0.4600	0.0000	0.7700	46.8874	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.8000	19.6403	0.4600	0.0000	0.7700	26.4350	(76)

Solar gains	170.4586	325.2824	526.2322	769.1105	954.6097	985.0110	934.4014	792.7321	611.1009	382.5123	210.8123	141.4268	(83)
Total gains	917.8069	1067.3730	1239.0083	1432.4273	1566.5528	1556.7018	1482.9826	1351.8824	1202.5020	1022.1074	900.5202	868.5173	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7071	34.8200	34.9314	35.4643	35.5658	36.0461	36.0461	36.1365	35.8596	35.5658	35.3610	35.1495	
alpha	3.3138	3.3213	3.3288	3.3643	3.3711	3.4031	3.4031	3.4091	3.3906	3.3711	3.3574	3.3433	
util living area	0.9845	0.9737	0.9481	0.8853	0.7713	0.6105	0.4696	0.5262	0.7557	0.9252	0.9751	0.9870	(86)
MIT	19.1345	19.3668	19.7606	20.2634	20.6595	20.8918	20.9666	20.9510	20.7675	20.2341	19.5997	19.1014	(87)
Th 2	19.8339	19.8373	19.8405	19.8559	19.8587	19.8722	19.8722	19.8746	19.8670	19.8587	19.8529	19.8468	(88)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util rest of house													
	0.9810	0.9677	0.9360	0.8582	0.7185	0.5251	0.3590	0.4125	0.6805	0.9016	0.9684	0.9840	(89)
MIT 2	17.3750	17.7128	18.2795	18.9919	19.5123	19.7899	19.8561	19.8488	19.6644	18.9709	18.0634	17.3349	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.5852	17.9104	18.4565	19.1438	19.6494	19.9215	19.9888	19.9805	19.7962	19.1218	18.2470	17.5459	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4352	17.7604	18.3065	18.9938	19.4994	19.7715	19.8388	19.8305	19.6462	18.9718	18.0970	17.3959	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9697	0.9520	0.9141	0.8330	0.6994	0.5169	0.3556	0.4077	0.6634	0.8769	0.9531	0.9741	(94)
Useful gains	889.9753	1016.1356	1132.6178	1193.1917	1095.6110	804.6116	527.3547	551.2171	797.7832	896.2830	858.2460	846.0231	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2267.7237	2213.0863	2025.2352	1705.4386	1314.0148	859.6718	538.3895	568.8296	926.7442	1410.4479	1863.4586	2249.5330	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1025.0448	804.3509	664.1073	368.8178	162.4924	0.0000	0.0000	0.0000	0.0000	382.5387	723.7531	1044.2114	(98)
Space heating												5175.3163	(98)
Space heating per m2											(98) / (4) =	39.2337	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5724.9074	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1025.0448	804.3509	664.1073	368.8178	162.4924	0.0000	0.0000	0.0000	0.0000	382.5387	723.7531	1044.2114	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1133.8991	889.7687	734.6320	407.9843	179.7483	0.0000	0.0000	0.0000	0.0000	423.1623	800.6118	1155.1011	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	178.7957	135.7586	110.6634	58.2042	23.5266	7.2542	1.6956	33.3579	63.8516	115.6562	154.2917	177.9503	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.6327	88.6807	88.6991	88.7755	88.8907	79.7000	79.7000	79.7000	79.7000	87.6677	88.3165	88.6668	(217)
Fuel for water heating, kWh/month													
	201.7266	153.0869	124.7627	65.5634	26.4669	9.1019	2.1275	41.8543	80.1150	131.9258	174.7032	200.6956	(219)
Water heating fuel used												1212.1298	(219)
Annual totals kWh/year													
Space heating fuel - main system												5724.9074	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												5810.1223	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5724.9074	3.4800	199.2268	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1212.1298	3.4800	42.1821	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	475.3244	13.1900	62.6953	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			212.7688	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5051	(257)
SAP value		92.9534	
SAP rating (Section 12)		93	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5724.9074	0.2160	1236.5800	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1212.1298	0.2160	261.8200	(264)
Space and water heating			1498.4000	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			913.5312	(272)
CO2 emissions per m2			6.9300	(273)
EI value			93.0805	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.5500 (1b)	x	2.5400 (2b)	=	169.0370	(1b) - (3b)
First floor	65.3600 (1c)	x	2.6200 (2c)	=	171.2432	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.2802	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1469	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3974	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3974	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4173	0.3974	0.3974	0.3676	0.3676	0.3279	0.3378	0.3180	0.3279	0.3478	0.3478	0.3776	(22b)
Effective ac	0.5871	0.5790	0.5790	0.5676	0.5676	0.5538	0.5571	0.5505	0.5538	0.5605	0.5605	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			22.7700	1.2357	28.1378			(27)
French Door (Uw = 1.30)			3.8000	1.2357	4.6958			(27)
GF B&B J150 P/A=0.50			66.5500	0.1200	7.9860	75.0000	4991.2500	(28a)
EW Brick AAC015	170.2100	30.8300	139.3800	0.2500	34.8450	52.3000	7289.5740	(29a)
Plane Ceiling	65.3600		65.3600	0.1600	10.4576	9.0000	588.2400	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			303.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0385			(33)
GF Timber			56.0300			9.0000	504.2700	(32c)
1F Timber			127.2800			9.0000	1145.5200	(32c)
GF Masonry			70.3600			75.0000	5277.0000	(32c)
Internal Floor			65.3600			18.0000	1176.4800	(32d)
Internal Ceiling			65.3600			9.0000	588.2400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21571.1940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.5296 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0429 (36)
Total fabric heat loss	(33) + (36) =	102.0814 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	65.9239	65.0149	65.0149	63.7345	63.7345	62.1825	62.5539	61.8222	62.1825	62.9363	62.9363	64.1502	(38)
Heat transfer coeff	168.0053	167.0963	167.0963	165.8159	165.8159	164.2639	164.6352	163.9036	164.2639	165.0177	165.0177	166.2316	(39)
Average = Sum(39)m / 12 =												165.5969	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2736	1.2667	1.2667	1.2570	1.2570	1.2453	1.2481	1.2425	1.2453	1.2510	1.2510	1.2602	(40)
HLP (average)												1.2554	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8998 (42)
Average daily hot water use (litres/day)	103.0697 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	113.3767	109.2539	105.1311	101.0083	96.8855	92.7627	92.7627	96.8855	101.0083	105.1311	109.2539	113.3767	(44)
Energy conte	168.1343	147.0513	151.7438	132.2939	126.9392	109.5389	101.5039	116.4772	117.8683	137.3641	149.9436	162.8291	(45)
Energy content (annual)										Total = Sum(45)m =		1621.6875	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.2201	22.0577	22.7616	19.8441	19.0409	16.4308	15.2256	17.4716	17.6802	20.6046	22.4915	24.4244	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.1279	181.3681	188.3416	162.3083	152.1384	133.7001	126.4705	142.3743	149.2333	173.9619	186.7116	200.8226	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1811	(H8)
Utilisation factor												0.5712	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												103.0697	(H14)
Volume ratio Veff/V												1.0624	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-961.9308	(H17)
Solar input	-29.6078	-44.5004	-74.9443	-103.5960	-124.7644	-131.3091	-128.1561	-114.4442	-89.3241	-60.7655	-35.9890	-24.5302	(63)
								Solar input (sum of months) = Sum(63)m =				-961.9308	(63)
Output from w/h													
	176.5201	136.8677	113.3973	58.7123	27.3740	2.3910	0.0000	27.9301	59.9093	113.1964	150.7226	176.2924	(64)
								Total per year (kWh/year) = Sum(64)m =				1043.3133	(64)
Heat gains from water heating, kWh/month													
	86.2995	76.3480	79.7331	67.9992	62.3667	55.7507	53.7233	59.4463	64.2833	74.9518	79.2706	84.5355	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	173.9866	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.2871	59.7638	48.6032	36.7957	27.5052	23.2211	25.0912	32.6145	43.7751	55.5826	64.8731	69.1572	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	447.7733	452.4198	440.7108	415.7837	384.3178	354.7443	334.9873	330.3408	342.0498	366.9769	398.4428	428.0164	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	55.2984	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	-115.9910	(71)
Water heating gains (Table 5)													
	115.9939	113.6131	107.1681	94.4433	83.8262	77.4315	72.2088	79.9010	89.2823	100.7417	110.0981	113.6230	(72)
Total internal gains													
	747.3483	742.0906	712.7760	663.3168	611.9432	571.6908	548.5812	559.1503	591.4012	639.5951	689.7079	727.0905	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.6800	11.9814	0.4600	0.0000	0.7700	32.5926	(74)
East	5.5700	22.3313	0.4600	0.0000	0.7700	44.0573	(76)
South	0.7200	50.9848	0.4600	0.0000	0.7700	13.0024	(78)
Southwest	1.0300	40.4699	0.4600	0.0000	0.7700	14.7645	(79)
West	6.7400	22.3313	0.4600	0.0000	0.7700	53.3117	(80)
Northwest	1.0300	12.9236	0.4600	0.0000	0.7700	4.7149	(81)
East	3.8000	22.3313	0.4600	0.0000	0.7700	30.0571	(76)

Solar gains	192.5004	331.1868	530.1346	798.6728	965.1248	1065.2137	999.7862	868.0073	667.4948	416.1476	244.0465	158.0731	(83)
Total gains	939.8487	1073.2774	1242.9106	1461.9896	1577.0680	1636.9044	1548.3674	1427.1576	1258.8960	1055.7427	933.7544	885.1636	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6655	35.8596	35.8596	36.1365	36.1365	36.4779	36.3956	36.5581	36.4779	36.3112	36.3112	36.0461	
alpha	3.3777	3.3906	3.3906	3.4091	3.4091	3.4319	3.4264	3.4372	3.4319	3.4207	3.4207	3.4031	
util living area													
	0.9808	0.9693	0.9370	0.8529	0.7023	0.4771	0.3247	0.3600	0.6571	0.8952	0.9663	0.9838	(86)
MIT	19.3372	19.5405	19.9452	20.4335	20.7910	20.9615	20.9926	20.9897	20.8798	20.4208	19.8121	19.3100	(87)
Th 2	19.8615	19.8670	19.8670	19.8746	19.8746	19.8840	19.8817	19.8861	19.8840	19.8794	19.8794	19.8722	(88)

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util rest of house													
	0.9762	0.9621	0.9219	0.8183	0.6358	0.3802	0.2099	0.2382	0.5617	0.8617	0.9570	0.9799	(89)
MIT 2	17.6864	17.9827	18.5599	19.2351	19.6827	19.8621	19.8800	19.8834	19.7967	19.2403	18.3862	17.6540	(90)
Living area fraction										fLA = Living area / (4) =		0.1195	(91)
MIT	17.8836	18.1688	18.7254	19.3783	19.8151	19.9935	20.0129	20.0156	19.9261	19.3814	18.5566	17.8518	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7336	18.0188	18.5754	19.2283	19.6651	19.8435	19.8629	19.8656	19.7761	19.2314	18.4066	17.7018	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9634	0.9453	0.8990	0.7945	0.6220	0.3765	0.2079	0.2359	0.5515	0.8366	0.9391	0.9685	(94)
Useful gains	905.4524	1014.6194	1117.3514	1161.5201	980.8589	616.3745	321.9725	336.7182	694.2447	883.2733	876.9068	857.2856	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2122.5187	2075.1345	1867.3717	1546.7792	1105.1871	631.3403	323.1657	338.5592	751.6912	1259.3133	1717.2668	2094.8253	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	905.4973	712.6661	558.0151	277.3866	92.5002	0.0000	0.0000	0.0000	0.0000	279.7738	605.0592	920.7296	(98)
Space heating												4351.6278	(98)
Space heating per m2											(98) / (4) =	32.9894	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4813.7476	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	905.4973	712.6661	558.0151	277.3866	92.5002	0.0000	0.0000	0.0000	0.0000	279.7738	605.0592	920.7296	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1001.6563	788.3475	617.2733	306.8436	102.3232	0.0000	0.0000	0.0000	0.0000	309.4843	669.3133	1018.5062	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.5201	136.8677	113.3973	58.7123	27.3740	2.3910	0.0000	27.9301	59.9093	113.1964	150.7226	176.2924	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4625	88.4861	88.3957	88.3285	87.7110	79.7000	79.7000	79.7000	79.7000	87.0342	88.0428	88.4908	(217)
Fuel for water heating, kWh/month													
	199.5423	154.6771	128.2838	66.4704	31.2094	3.0000	0.0000	35.0440	75.1685	130.0597	171.1925	199.2211	(219)
Water heating fuel used												1193.8687	(219)
Annual totals kWh/year													
Space heating fuel - main system												4813.7476	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												475.3244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												4783.7811	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4813.7476	3.9200	188.6989	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1193.8687	3.9200	46.7997	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	475.3244	16.9600	80.6150	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			115.9361	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy	Emission factor	Emissions	

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	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	4813.7476	0.2160	1039.7695	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1193.8687	0.2160	257.8756	(264)
Space and water heating			1297.6451	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	475.3244	0.5190	246.6934	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			662.4747	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4813.7476	1.2200	5872.7721	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1193.8687	1.2200	1456.5198	(264)
Space and water heating			7329.2919	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	475.3244	3.0700	1459.2460	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			3572.1178	(272)
Primary energy kWh/m2/year			27.0800	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	163.5 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		449.17 (P1)
Transmission heat loss coefficient		102.08 (37)
Summer heat loss coefficient		551.25 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
South West	0.000	1.000	None
West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.6800	81.1852	0.4600	0.0000	0.9000	258.1299
East	5.5700	117.5071	0.4600	0.0000	0.9000	270.9689
South	0.7200	112.2060	0.4600	0.0000	0.9000	33.4464
South West	1.0300	119.9223	0.4600	0.0000	0.9000	51.1373
West	6.7400	117.5071	0.4600	0.0000	0.9000	327.8870
North West	1.0300	98.8453	0.4600	0.0000	0.9000	42.1496
East	3.8000	117.5071	0.4600	0.0000	0.9000	184.8621
total:						1168.5812

	Jun	Jul	Aug	
Solar gains	1245	1169	1015	(P4)
Internal gains	591	568	578	
Total summer gains	1836	1737	1592	(P5)
Summer gain/loss ratio	3.33	3.15	2.89	(P6)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 163.5)	0.86	0.86	0.86	
Threshold temperature	20.19	21.91	21.54	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			