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

AES Sustainability Consultants

Property Reference	4907-P637-6633-650	**Issued on Date**	19/06/2023
Assessment Reference	As Built	**Prop Type Ref**	Bowyer-CB-As-DET
Property	6, Flycatcher Road , BOTLEY, SO32 2FG		

SAP Rating	91 B	**DER**	10.46	**TER**	16.55
Environmental	91 B	**% DER<TER**	36.81		
CO_2 Emissions (t/year)	0.92	**DFEE**	46.29	**TFEE**	56.58
General Requirements Compliance	Pass	**% DFEE<TFEE**	18.19		

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

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

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DWELLING AS BUILT

Detached House, total floor area 124 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.55 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.46 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.27 (max. 2.00)	1.40 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.91 (measured in this dwelling)
Maximum 10.0 OK

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

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.40 kWh/day
Permitted by DBSCG 2.10 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Southern England): Medium OK
Based on:
Overshading: Average
Windows facing North: 2.39 m², No overhang
Windows facing East: 8.19 m², No overhang
Windows facing South: 10.45 m², No overhang
Windows facing West: 5.99 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 0.80 W/m²K
Thermal bridging y-value 0.032 W/m²K
Photovoltaic array 1.48 kW

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		310.0149	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =		0.1613	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.4068	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5186	0.5085	0.4983	0.4475	0.4373	0.3864	0.3864	0.3763	0.4068	0.4373	0.4576	0.4780	(22b)
Effective ac	0.6345	0.6293	0.6242	0.6001	0.5956	0.5747	0.5747	0.5708	0.5827	0.5956	0.6047	0.6142	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			18.0000	1099.6200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16986.5980	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.8893	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.9122	64.3779	63.8542	61.3943	60.9340	58.7915	58.7915	58.3947	59.6168	60.9340	61.8651	62.8385	(38)
Heat transfer coeff	158.2036	157.6693	157.1455	154.6856	154.2254	152.0828	152.0828	151.6861	152.9081	154.2254	155.1564	156.1298	(39)
Average = Sum(39)m / 12 =												154.6834	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2749	1.2706	1.2664	1.2466	1.2429	1.2256	1.2256	1.2224	1.2322	1.2429	1.2504	1.2582	(40)
HLP (average)												1.2465	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
								Total per year (kWh/year) = Sum(64)m =				2163.3212	(64)
Heat gains from water heating, kWh/month													
	92.9806	82.3906	87.5583	79.9188	79.3525	72.3911	70.9380	75.8915	75.1466	82.8013	85.7577	91.2256	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9121	23.0149	18.7170	14.1700	10.5922	8.9424	9.6626	12.5598	16.8577	21.4047	24.9825	26.6323	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	290.4464	293.4603	285.8653	269.6965	249.2862	230.1035	217.2882	214.2743	221.8693	238.0381	258.4484	277.6312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	124.9739	122.6051	117.6859	110.9984	106.6566	100.5431	95.3468	102.0047	104.3702	111.2920	119.1079	122.6150	(72)
Total internal gains													
	510.4999	508.2478	491.4357	464.0323	435.7025	408.7564	391.4650	398.0062	412.2646	439.9023	471.7062	496.0458	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	10.6334	0.4600	0.0000	0.7700	9.0016	(74)
East	4.8600	19.6403	0.4600	0.0000	0.7700	33.8090	(76)
South	10.4500	46.7521	0.4600	0.0000	0.7700	173.0476	(78)
West	5.9900	19.6403	0.4600	0.0000	0.7700	41.6699	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	280.6935	493.5791	708.0348	918.4552	1056.4468	1058.3550	1016.5881	913.9246	781.8699	555.1330	339.2229	238.1535	(83)
Total gains	791.1934	1001.8269	1199.4705	1382.4875	1492.1493	1467.1114	1408.0531	1311.9307	1194.1346	995.0353	810.9291	734.1994	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8255	29.9266	30.0263	30.5038	30.5948	31.0259	31.0259	31.1070	30.8584	30.5948	30.4112	30.2216	
alpha	2.9884	2.9951	3.0018	3.0336	3.0397	3.0684	3.0684	3.0738	3.0572	3.0397	3.0274	3.0148	
util living area													
	0.9808	0.9617	0.9253	0.8522	0.7374	0.5853	0.4485	0.4931	0.7051	0.8959	0.9671	0.9844	(86)
MIT	18.8765	19.2055	19.6668	20.2046	20.6165	20.8678	20.9566	20.9414	20.7546	20.1821	19.4276	18.8277	(87)
Th 2	19.8605	19.8639	19.8673	19.8829	19.8859	19.8996	19.8996	19.9021	19.8943	19.8859	19.8799	19.8737	(88)
util rest of house													
	0.9769	0.9543	0.9107	0.8234	0.6865	0.5062	0.3466	0.3896	0.6325	0.8690	0.9594	0.9813	(89)
MIT 2	17.0458	17.5222	18.1829	18.9414	19.4854	19.7926	19.8762	19.8681	19.6738	18.9318	17.8582	16.9826	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	17.3739	17.8239	18.4489	19.1678	19.6882	19.9853	20.0698	20.0604	19.8675	19.1558	18.1395	17.3133	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2239	17.6739	18.2989	19.0178	19.5382	19.8353	19.9198	19.9104	19.7175	19.0058	17.9895	17.1633	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9632	0.9339	0.8842	0.7966	0.6685	0.5012	0.3485	0.3904	0.6193	0.8416	0.9406	0.9695	(94)
Useful gains	762.1169	935.5772	1060.5940	1101.2916	997.5733	735.3180	490.7541	512.1775	739.5272	837.3985	762.7239	711.8160	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2044.6064	2014.0506	1854.1400	1565.0805	1208.8432	796.1965	504.8914	532.4842	858.9622	1296.3950	1689.5711	2023.9540	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh														
	954.1722	724.7341	590.3982	333.9280	157.1848	0.0000	0.0000	0.0000	0.0000	341.4934	667.3300	976.2307	(98)	
Space heating												4745.4713	(98)	
Space heating per m2											(98) / (4) =	38.2422	(99)	

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5249.4151	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	954.1722	724.7341	590.3982	333.9280	157.1848	0.0000	0.0000	0.0000	0.0000	341.4934	667.3300	976.2307	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1055.5002	801.6970	653.0954	369.3894	173.8770	0.0000	0.0000	0.0000	0.0000	377.7582	738.1969	1079.9012	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.2302	87.9626	87.4549	86.3850	84.4591	79.7000	79.7000	79.7000	79.7000	86.3499	87.7428	88.3118	(217)
Fuel for water heating, kWh/month													
	242.5273	214.2806	226.0304	204.6846	204.8277	193.4464	185.3060	203.9980	203.8445	212.3543	221.5307	236.3263	(219)
Water heating fuel used												2549.1568	(219)
Annual totals kWh/year													
Space heating fuel - main system												5249.4151	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												457.6163	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												7053.0310	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5249.4151	0.2160	1133.8737	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2549.1568	0.2160	550.6179	(264)
Space and water heating			1684.4915	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.6163	0.5190	237.5028	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1297.5558	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.4600	(273)

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

DER		10.4600	ZC1
Total Floor Area	TFA	124.0900	
Assumed number of occupants	N	2.8778	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.8700	ZC2
CO2 emissions from cooking, equation (L16)		1.5156	ZC3
Total CO2 emissions		25.8455	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.8455	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	310.0149	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1290	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3790	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3790	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4833	0.4738	0.4643	0.4169	0.4075	0.3601	0.3601	0.3506	0.3790	0.4075	0.4264	0.4454	(22b)
Effective ac	0.6168	0.6122	0.6078	0.5869	0.5830	0.5648	0.5648	0.5615	0.5718	0.5830	0.5909	0.5992	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0300	1.0000	2.0300			(26)
TER Semi-glazed door			2.0300	1.2000	2.4360			(26a)
TER Opening Type (Uw = 1.40)			26.9900	1.3258	35.7822			(27)
GF B&B J150 P/A=0.50			63.0000	0.1300	8.1900			(28a)
EW Brick AAC011	162.4600	31.0500	131.4100	0.1800	23.6538			(29a)
PR 400mm MW044	61.0900		61.0900	0.1300	7.9417			(30)
PR 300mm MW044	1.9100		1.9100	0.1300	0.2483			(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	80.2820			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8690	(36)
Total fabric heat loss						(33) + (36) =	94.1510	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.0985	62.6346	62.1800	60.0443	59.6447	57.7846	57.7846	57.4401	58.5011	59.6447	60.4530	61.2981	(38)
Heat transfer coeff	157.2495	156.7856	156.3309	154.1953	153.7957	151.9356	151.9356	151.5911	152.6521	153.7957	154.6040	155.4491	(39)
Average = Sum(39)m / 12 =												154.1933	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2672	1.2635	1.2598	1.2426	1.2394	1.2244	1.2244	1.2216	1.2302	1.2394	1.2459	1.2527	(40)
HLP (average)												1.2426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												180.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	216.5266	190.7848	200.2190	179.2790	175.5398	156.6390	150.2331	165.1307	164.9263	185.9120	196.8394	211.2482	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	216.5266	190.7848	200.2190	179.2790	175.5398	156.6390	150.2331	165.1307	164.9263	185.9120	196.8394	211.2482	(64)
								Total per year (kWh/year) = Sum(64)m =				2193.2779	(64)
Heat gains from water heating, kWh/month	95.0160	84.2291	89.5938	81.8886	81.3879	74.3608	72.9735	77.9269	77.1163	84.8367	87.7275	93.2610	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.9133	23.0160	18.7179	14.1706	10.5927	8.9428	9.6630	12.5604	16.8585	21.4057	24.9836	26.6335	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.4464	293.4603	285.8653	269.6965	249.2862	230.1035	217.2882	214.2743	221.8693	238.0381	258.4484	277.6312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)	127.7097	125.3409	120.4217	113.7342	109.3924	103.2789	98.0826	104.7405	107.1060	114.0278	121.8437	125.3508	(72)
Total internal gains	513.2368	510.9846	494.1723	466.7687	438.4387	411.4926	394.2012	400.7425	415.0012	442.6390	474.4431	498.7828	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	10.6334	0.6300	0.7000	0.7700	7.7668	(74)
East	8.1800	19.6403	0.6300	0.7000	0.7700	49.0990	(76)
South	10.4400	46.7521	0.6300	0.7000	0.7700	149.1671	(78)
West	5.9800	19.6403	0.6300	0.7000	0.7700	35.8939	(80)

Solar gains	241.9268	425.4041	610.2261	791.5662	910.4876	912.1308	876.1349	787.6587	673.8566	478.4522	292.3713	205.2629	(83)
Total gains	755.1636	936.3887	1104.3984	1258.3349	1348.9263	1323.6234	1270.3362	1188.4012	1088.8578	921.0912	766.8144	704.0457	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.8006	54.9627	55.1226	55.8860	56.0312	56.7172	56.7172	56.8461	56.4510	56.0312	55.7383	55.4353	
alpha	4.6534	4.6642	4.6748	4.7257	4.7354	4.7811	4.7811	4.7897	4.7634	4.7354	4.7159	4.6957	
util living area	0.9978	0.9938	0.9819	0.9435	0.8489	0.6810	0.5144	0.5670	0.8125	0.9675	0.9950	0.9984	(86)
MIT	19.6124	19.8183	20.1227	20.4949	20.7876	20.9470	20.9887	20.9824	20.8742	20.4725	19.9690	19.5820	(87)
Th 2	19.8666	19.8695	19.8724	19.8861	19.8886	19.9005	19.9005	19.9027	19.8959	19.8886	19.8835	19.8781	(88)
util rest of house	0.9971	0.9917	0.9755	0.9228	0.7961	0.5850	0.3919	0.4415	0.7313	0.9516	0.9929	0.9979	(89)
MIT 2	18.0271	18.3291	18.7713	19.3053	19.6863	19.8665	19.8966	19.8959	19.7993	19.2865	18.5598	17.9906	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	18.3112	18.5960	19.0135	19.5185	19.8837	20.0602	20.0923	20.0906	19.9920	19.4991	18.8123	18.2758	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3112	18.5960	19.0135	19.5185	19.8837	20.0602	20.0923	20.0906	19.9920	19.4991	18.8123	18.2758	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9881	0.9687	0.9143	0.7959	0.5999	0.4139	0.4639	0.7394	0.9441	0.9899	0.9967	(94)
Useful gains	751.7528	925.2849	1069.8376	1150.5184	1073.5614	794.0371	525.8258	551.3418	805.1226	869.6018	759.0721	701.7165	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2203.2600	2147.3338	1956.2474	1637.3226	1258.6201	829.5967	530.6121	559.4672	899.4208	1368.6412	1810.7749	2188.0752	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1079.9214	821.2169	659.4889	350.4990	137.6837	0.0000	0.0000	0.0000	0.0000	371.2853	757.2260	1105.8509	(98)
Space heating												5283.1721	(98)
Space heating per m2											(98) / (4) =	42.5753	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5650.4514	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1079.9214	821.2169	659.4889	350.4990	137.6837	0.0000	0.0000	0.0000	0.0000	371.2853	757.2260	1105.8509	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1154.9961	878.3069	705.3357	374.8652	147.2553	0.0000	0.0000	0.0000	0.0000	397.0966	809.8674	1182.7282	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	216.5266	190.7848	200.2190	179.2790	175.5398	156.6390	150.2331	165.1307	164.9263	185.9120	196.8394	211.2482	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5177	88.2687	87.7595	86.5718	84.1747	79.8000	79.8000	79.8000	79.8000	86.6246	88.0638	88.5947	(217)
Fuel for water heating, kWh/month	244.6138	216.1409	228.1451	207.0870	208.5423	196.2895	188.2621	206.9307	206.6746	214.6181	223.5191	238.4434	(219)
Water heating fuel used												2579.2666	(219)
Annual totals kWh/year													
Space heating fuel - main system												5650.4514	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	457.6373	(232)
Total delivered energy for all uses	8762.3553	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5650.4514	0.2160	1220.4975	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2579.2666	0.2160	557.1216	(264)
Space and water heating			1777.6191	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.6373	0.5190	237.5137	(268)
Total CO2, kg/m2/year			2054.0578	(272)
Emissions per m2 for space and water heating			14.3252	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9140	(272b)
Emissions per m2 for pumps and fans			0.3137	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.3252 * 1.00) + 1.9140 + 0.3137, rounded to 2 d.p.			16.5500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		310.0149	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1290	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.3745	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3745	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4775	0.4682	0.4588	0.4120	0.4026	0.3558	0.3558	0.3464	0.3745	0.4026	0.4213	0.4401	(22b)
Effective ac	0.6140	0.6096	0.6052	0.5849	0.5810	0.5633	0.5633	0.5600	0.5701	0.5810	0.5888	0.5968	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			9.0000	549.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16436.7880	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	132.4586	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	62.8166	62.3636	61.9197	59.8344	59.4442	57.6280	57.6280	57.2917	58.3276	59.4442	60.2335	61.0586	(38)
Heat transfer coeff	156.1079	155.6550	155.2110	153.1257	152.7356	150.9194	150.9194	150.5830	151.6189	152.7356	153.5248	154.3500	(39)
Average = Sum(39)m / 12 =												153.1239	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2580	1.2544	1.2508	1.2340	1.2308	1.2162	1.2162	1.2135	1.2218	1.2308	1.2372	1.2439	(40)
HLP (average)												1.2340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.5478	31.0904	32.0825	27.9703	26.8381	23.1593	21.4605	24.6262	24.9203	29.0422	31.7019	34.4262	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9121	23.0149	18.7170	14.1700	10.5922	8.9424	9.6626	12.5598	16.8577	21.4047	24.9825	26.6323	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	290.4464	293.4603	285.8653	269.6965	249.2862	230.1035	217.2882	214.2743	221.8693	238.0381	258.4484	277.6312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	47.7793	46.2654	43.1216	38.8476	36.0728	32.1657	28.8447	33.0997	34.6116	39.0353	44.0304	46.2717	(72)
Total internal gains													
	430.3053	428.9081	413.8713	388.8815	362.1186	337.3789	321.9629	326.1012	339.5059	364.6455	393.6286	416.7026	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	10.6334	0.4600	0.0000	0.7700	9.0016	(74)
East	4.8600	19.6403	0.4600	0.0000	0.7700	33.8090	(76)
South	10.4500	46.7521	0.4600	0.0000	0.7700	173.0476	(78)
West	5.9900	19.6403	0.4600	0.0000	0.7700	41.6699	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	280.6935	493.5791	708.0348	918.4552	1056.4468	1058.3550	1016.5881	913.9246	781.8699	555.1330	339.2229	238.1535	(83)
Total gains	710.9988	922.4872	1121.9061	1307.3367	1418.5654	1395.7339	1338.5510	1240.0258	1121.3759	919.7785	732.8516	654.8561	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.2476	29.3327	29.4166	29.8172	29.8933	30.2531	30.2531	30.3206	30.1135	29.8933	29.7396	29.5807	
alpha	2.9498	2.9555	2.9611	2.9878	2.9929	3.0169	3.0169	3.0214	3.0076	2.9929	2.9826	2.9720	
util living area													
	0.9842	0.9664	0.9318	0.8617	0.7500	0.6011	0.4640	0.5116	0.7239	0.9075	0.9725	0.9874	(86)
MIT	18.7724	19.1123	19.5896	20.1460	20.5805	20.8500	20.9492	20.9311	20.7233	20.1129	19.3302	18.7175	(87)
Th 2	19.8739	19.8767	19.8796	19.8929	19.8954	19.9071	19.9071	19.9092	19.9026	19.8954	19.8904	19.8851	(88)
util rest of house													
	0.9810	0.9600	0.9187	0.8347	0.7009	0.5226	0.3607	0.4069	0.6535	0.8833	0.9662	0.9849	(89)
MIT 2	17.8490	18.1865	18.6554	19.1967	19.5924	19.8224	19.8878	19.8810	19.7292	19.1807	18.4153	17.8025	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	18.0144	18.3524	18.8228	19.3669	19.7695	20.0066	20.0781	20.0692	19.9074	19.3477	18.5792	17.9665	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0144	18.3524	18.8228	19.3669	19.7695	20.0066	20.0781	20.0692	19.9074	19.3477	18.5792	17.9665	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9738	0.9484	0.9031	0.8197	0.6947	0.5302	0.3777	0.4232	0.6539	0.8685	0.9560	0.9789	(94)
Useful gains	692.3774	874.8600	1013.1930	1071.6425	985.4446	740.0665	505.5161	524.8178	733.2341	798.7846	700.6166	641.0223	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2140.9339	2093.9398	1912.6348	1602.7451	1232.4977	815.9629	524.9068	552.5266	880.5064	1336.0922	1762.3475	2124.8529	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1077.7260	819.2216	669.1848	382.3939	183.8075	0.0000	0.0000	0.0000	0.0000	399.7568	764.4462	1103.9700	(98)
Space heating												5400.5069	(98)
Space heating per m2											(98) / (4) =	43.5209	(99)

8c. Space cooling requirement

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1418.6421	1116.8033	1144.4311	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8231	0.8784	0.8542	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1167.7509	981.0073	977.6195	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1747.6993	1678.2331	1565.2364	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	417.5629	518.7360	437.1870	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1373.4858	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	104.3907	129.6840	109.2967	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												343.3714	(107)
Space cooling per m2												2.7671	(108)
Energy for space heating												43.5209	(99)
Energy for space cooling												2.7671	(108)
Total												46.2880	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 124.0900						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.0149	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =		0.1290	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3790	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3790	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4833	0.4738	0.4643	0.4169	0.4075	0.3601	0.3601	0.3506	0.3790	0.4075	0.4264	0.4454	(22b)
Effective ac	0.6168	0.6122	0.6078	0.5869	0.5830	0.5648	0.5648	0.5615	0.5718	0.5830	0.5909	0.5992	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0300	1.0000	2.0300			(26)
TER Semi-glazed door			2.0300	1.2000	2.4360			(26a)
TER Opening Type (Uw = 1.40)			26.9900	1.3258	35.7822			(27)
GF B&B J150 P/A=0.50			63.0000	0.1300	8.1900			(28a)
EW Brick AAC011	162.4600	31.0500	131.4100	0.1800	23.6538			(29a)
PR 400mm MW044	61.0900		61.0900	0.1300	7.9417			(30)
PR 300mm MW044	1.9100		1.9100	0.1300	0.2483			(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	80.2820			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.8690	(36)
Total fabric heat loss					(33) + (36) =		94.1510	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.0985	62.6346	62.1800	60.0443	59.6447	57.7846	57.7846	57.4401	58.5011	59.6447	60.4530	61.2981	(38)
Heat transfer coeff	157.2495	156.7856	156.3309	154.1953	153.7957	151.9356	151.9356	151.5911	152.6521	153.7957	154.6040	155.4491	(39)
Average = Sum(39)m / 12 =												154.1933	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2672	1.2635	1.2598	1.2426	1.2394	1.2244	1.2244	1.2216	1.2302	1.2394	1.2459	1.2527	(40)
HLP (average)												1.2426	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.5478	31.0904	32.0825	27.9703	26.8381	23.1593	21.4605	24.6262	24.9203	29.0422	31.7019	34.4262	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	143.8913	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9133	23.0160	18.7179	14.1706	10.5927	8.9428	9.6630	12.5604	16.8585	21.4057	24.9836	26.6335	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	290.4464	293.4603	285.8653	269.6965	249.2862	230.1035	217.2882	214.2743	221.8693	238.0381	258.4484	277.6312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	37.3891	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	47.7793	46.2654	43.1216	38.8476	36.0728	32.1657	28.8447	33.0997	34.6116	39.0353	44.0304	46.2717	(72)
Total internal gains													
	430.3065	428.9091	413.8722	388.8821	362.1191	337.3793	321.9633	326.1018	339.5067	364.6465	393.6298	416.7038	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	10.6334	0.6300	0.7000	0.7700	7.7668	(74)
East	8.1800	19.6403	0.6300	0.7000	0.7700	49.0990	(76)
South	10.4400	46.7521	0.6300	0.7000	0.7700	149.1671	(78)
West	5.9800	19.6403	0.6300	0.7000	0.7700	35.8939	(80)

Solar gains	241.9268	425.4041	610.2261	791.5662	910.4876	912.1308	876.1349	787.6587	673.8566	478.4522	292.3713	205.2629	(83)
Total gains	672.2332	854.3132	1024.0983	1180.4483	1272.6067	1249.5102	1198.0983	1113.7605	1013.3633	843.0987	686.0011	621.9667	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.8006	54.9627	55.1226	55.8860	56.0312	56.7172	56.7172	56.8461	56.4510	56.0312	55.7383	55.4353	
alpha	4.6534	4.6642	4.6748	4.7257	4.7354	4.7811	4.7811	4.7897	4.7634	4.7354	4.7159	4.6957	
util living area													
	0.9987	0.9958	0.9865	0.9545	0.8701	0.7102	0.5423	0.5995	0.8421	0.9766	0.9969	0.9991	(86)
MIT	19.5515	19.7590	20.0677	20.4499	20.7595	20.9366	20.9860	20.9778	20.8508	20.4220	19.9102	19.5214	(87)
Th 2	19.8666	19.8695	19.8724	19.8861	19.8886	19.9005	19.9005	19.9027	19.8959	19.8886	19.8835	19.8781	(88)
util rest of house													
	0.9982	0.9943	0.9815	0.9370	0.8213	0.6141	0.4147	0.4695	0.7661	0.9645	0.9955	0.9988	(89)
MIT 2	18.5500	18.7591	19.0671	19.4485	19.7291	19.8721	19.8971	19.8967	19.8151	19.4304	18.9213	18.5289	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	18.7295	18.9383	19.2464	19.6280	19.9138	20.0629	20.0923	20.0905	20.0007	19.6081	19.0986	18.7068	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7295	18.9383	19.2464	19.6280	19.9138	20.0629	20.0923	20.0905	20.0007	19.6081	19.0986	18.7068	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9926	0.9779	0.9320	0.8226	0.6294	0.4378	0.4929	0.7745	0.9604	0.9942	0.9983	(94)
Useful gains	670.5854	847.9553	1001.4190	1100.1970	1046.8241	786.5039	524.5265	548.9558	784.8698	809.7530	682.0210	620.9021	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2269.0266	2201.0024	1992.6633	1654.2066	1263.2447	830.0069	530.6001	559.4402	900.7540	1385.4059	1855.0266	2255.0718	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1189.2403	909.2477	737.4858	398.8869	161.0169	0.0000	0.0000	0.0000	0.0000	428.2857	844.5640	1215.8222	(98)
Space heating												5884.5495	(98)
Space heating per m2											(98) / (4) =	47.4216	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1428.1943	1124.3232	1152.0924	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8653	0.9244	0.9008	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1235.7612	1039.3700	1037.7840	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1576.7890	1514.0682	1417.6544	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	245.5400	353.1754	282.6235	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												881.3389	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	61.3850	88.2939	70.6559	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												220.3347	(107)
Space cooling per m2												1.7756	(108)
Energy for space heating												47.4216	(99)
Energy for space cooling												1.7756	(108)
Total												49.1972	(109)
Target Fabric Energy Efficiency (TFEE)												56.6	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		310.0149	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =		0.1613	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.4068	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4271	0.3966	0.4068	0.3864	0.3864	0.3763	0.3661	0.3559	0.3458	0.3763	0.3559	0.3763	(22b)
Effective ac	0.5912	0.5787	0.5827	0.5747	0.5747	0.5708	0.5670	0.5633	0.5598	0.5708	0.5633	0.5708	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			18.0000	1099.6200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16986.5980	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.8893	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.4844	59.1988	59.6168	58.7915	58.7915	58.3947	58.0085	57.6329	57.2679	58.3947	57.6329	58.3947	(38)
Heat transfer coeff	153.7757	152.4902	152.9081	152.0828	152.0828	151.6861	151.2999	150.9243	150.5593	151.6861	150.9243	151.6861	(39)
Average = Sum(39)m / 12 =												151.8421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2392	1.2289	1.2322	1.2256	1.2256	1.2224	1.2193	1.2162	1.2133	1.2224	1.2162	1.2224	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
								Total per year (kWh/year) = Sum(64)m =				2163.3212	(64)
RHI water heating demand												2163	(64)
Heat gains from water heating, kWh/month													
	92.9806	82.3906	87.5583	79.9188	79.3525	72.3911	70.9380	75.8915	75.1466	82.8013	85.7577	91.2256	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7803	57.5373	46.7925	35.4249	26.4805	22.3560	24.1564	31.3994	42.1443	53.5118	62.4562	66.5808	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.5021	438.0005	426.6647	402.5321	372.0690	343.4380	324.3108	319.8124	331.1482	355.2808	385.7439	414.3749	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	124.9739	122.6051	117.6859	110.9984	106.6566	100.5431	95.3468	102.0047	104.3702	111.2920	119.1079	122.6150	(72)
Total internal gains													
	738.9577	733.8442	706.8444	664.6567	620.9075	582.0385	559.5154	568.9178	593.3640	635.7860	683.0093	719.2719	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	13.4839	0.4600	0.0000	0.7700	11.4146	(74)
East	4.8600	25.1925	0.4600	0.0000	0.7700	43.3667	(76)
South	10.4500	56.7559	0.4600	0.0000	0.7700	210.0756	(78)
West	5.9900	25.1925	0.4600	0.0000	0.7700	53.4500	(80)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	348.0212	521.1194	755.0255	989.2055	1085.5405	1183.4844	1126.9613	1034.8273	881.7780	632.6882	419.2627	290.2466	(83)
Total gains	1086.9788	1254.9636	1461.8699	1653.8622	1706.4480	1765.5229	1686.4767	1603.7451	1475.1420	1268.4742	1102.2720	1009.5185	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	30.6843	30.9430	30.8584	31.0259	31.0259	31.1070	31.1864	31.2640	31.3398	31.1070	31.2640	31.1070	
alpha	3.0456	3.0629	3.0572	3.0684	3.0684	3.0738	3.0791	3.0843	3.0893	3.0738	3.0843	3.0738	
util living area													
	0.9526	0.9291	0.8745	0.7749	0.6418	0.4603	0.3408	0.3563	0.5728	0.8039	0.9196	0.9595	(86)
MIT	19.3447	19.5845	20.0071	20.4608	20.7722	20.9400	20.9823	20.9801	20.8801	20.4960	19.8857	19.3162	(87)
Th 2	19.8887	19.8970	19.8943	19.8996	19.8996	19.9021	19.9046	19.9070	19.9094	19.9021	19.9070	19.9021	(88)
util rest of house													
	0.9438	0.9164	0.8526	0.7371	0.5828	0.3813	0.2489	0.2609	0.4934	0.7607	0.9027	0.9517	(89)
MIT 2	17.7359	18.0810	18.6712	19.2871	19.6785	19.8600	19.8969	19.8983	19.8137	19.3531	18.5228	17.7044	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	18.0242	18.3505	18.9107	19.4974	19.8745	20.0535	20.0914	20.0922	20.0048	19.5579	18.7671	17.9933	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8742	18.2005	18.7607	19.3474	19.7245	19.9035	19.9414	19.9422	19.8548	19.4079	18.6171	17.8433	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9217	0.8911	0.8253	0.7156	0.5726	0.3814	0.2521	0.2641	0.4892	0.7379	0.8766	0.9314	(94)
Useful gains	1001.8571	1118.2768	1206.4548	1183.5055	977.0891	673.3330	425.1280	423.5476	721.5859	936.0676	966.2917	940.2873	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1995.1201	1967.2001	1798.3006	1497.6256	1098.7183	698.2918	429.9084	428.9525	776.1052	1214.6923	1617.4688	1948.1424	(97)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	738.9876	570.4764	440.3333	226.1665	90.4921	0.0000	0.0000	0.0000	0.0000	207.2968	468.8475	749.8442	(98)
Space heating												3492.4444	(98)
RHI space heating demand												3492	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 124.0900						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.0149	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1613	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.4068	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5186	0.5085	0.4983	0.4475	0.4373	0.3864	0.3864	0.3763	0.4068	0.4373	0.4576	0.4780	(22b)
Effective ac	0.6345	0.6293	0.6242	0.6001	0.5956	0.5747	0.5747	0.5708	0.5827	0.5956	0.6047	0.6142	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			18.0000	1099.6200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16986.5980	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.8893	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.9122	64.3779	63.8542	61.3943	60.9340	58.7915	58.7915	58.3947	59.6168	60.9340	61.8651	62.8385	(38)
Heat transfer coeff	158.2036	157.6693	157.1455	154.6856	154.2254	152.0828	152.0828	151.6861	152.9081	154.2254	155.1564	156.1298	(39)
Average = Sum(39)m / 12 =												154.6834	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2749	1.2706	1.2664	1.2466	1.2429	1.2256	1.2256	1.2224	1.2322	1.2429	1.2504	1.2582	(40)
HLP (average)												1.2465	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
								Total per year (kWh/year) = Sum(64)m =				2163.3212	(64)
Heat gains from water heating, kWh/month													
	92.9806	82.3906	87.5583	79.9188	79.3525	72.3911	70.9380	75.8915	75.1466	82.8013	85.7577	91.2256	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7803	57.5373	46.7925	35.4249	26.4805	22.3560	24.1564	31.3994	42.1443	53.5118	62.4562	66.5808	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.5021	438.0005	426.6647	402.5321	372.0690	343.4380	324.3108	319.8124	331.1482	355.2808	385.7439	414.3749	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	124.9739	122.6051	117.6859	110.9984	106.6566	100.5431	95.3468	102.0047	104.3702	111.2920	119.1079	122.6150	(72)
Total internal gains													
	738.9577	733.8442	706.8444	664.6567	620.9075	582.0385	559.5154	568.9178	593.3640	635.7860	683.0093	719.2719	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	10.6334	0.4600	0.0000	0.7700	9.0016	(74)
East	4.8600	19.6403	0.4600	0.0000	0.7700	33.8090	(76)
South	10.4500	46.7521	0.4600	0.0000	0.7700	173.0476	(78)
West	5.9900	19.6403	0.4600	0.0000	0.7700	41.6699	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	280.6935	493.5791	708.0348	918.4552	1056.4468	1058.3550	1016.5881	913.9246	781.8699	555.1330	339.2229	238.1535	(83)
Total gains	1019.6512	1227.4233	1414.8792	1583.1119	1677.3543	1640.3935	1576.1034	1482.8424	1375.2340	1190.9190	1022.2322	957.4254	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.8255	29.9266	30.0263	30.5038	30.5948	31.0259	31.0259	31.1070	30.8584	30.5948	30.4112	30.2216	
alpha	2.9884	2.9951	3.0018	3.0336	3.0397	3.0684	3.0684	3.0738	3.0572	3.0397	3.0274	3.0148	
util living area													
	0.9635	0.9380	0.8935	0.8111	0.6908	0.5381	0.4064	0.4448	0.6466	0.8511	0.9423	0.9690	(86)
MIT	19.1115	19.4196	19.8429	20.3260	20.6837	20.8955	20.9669	20.9559	20.8091	20.3223	19.6327	19.0620	(87)
Th 2	19.8605	19.8639	19.8673	19.8829	19.8859	19.8996	19.8996	19.9021	19.8943	19.8859	19.8799	19.8737	(88)
util rest of house													
	0.9567	0.9269	0.8745	0.7780	0.6377	0.4614	0.3118	0.3483	0.5724	0.8170	0.9300	0.9632	(89)
MIT 2	17.3833	17.8253	18.4250	19.0980	19.5616	19.8167	19.8822	19.8772	19.7277	19.1138	18.1478	17.3204	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	17.6930	18.1110	18.6792	19.3181	19.7627	20.0101	20.0766	20.0705	19.9215	19.3304	18.4139	17.6325	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5430	17.9610	18.5292	19.1681	19.6127	19.8601	19.9266	19.9205	19.7715	19.1804	18.2639	17.4825	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9368	0.9018	0.8464	0.7533	0.6233	0.4585	0.3143	0.3500	0.5633	0.7906	0.9057	0.9452	(94)
Useful gains	955.1586	1106.9194	1197.5614	1192.5834	1045.5439	752.1350	495.3007	518.9779	774.7370	941.5247	925.8312	904.9252	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2095.0976	2059.3225	1890.3275	1588.3221	1220.3409	799.9652	505.9170	534.0132	867.2201	1323.3089	1732.1550	2073.7977	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh													
	848.1146	640.0149	515.4179	284.9319	130.0490	0.0000	0.0000	0.0000	0.0000	284.0474	580.5531	869.6412	(98)
Space heating												4152.7700	(98)
Space heating per m2											(98) / (4) =	33.4658	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4593.7721	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	848.1146	640.0149	515.4179	284.9319	130.0490	0.0000	0.0000	0.0000	0.0000	284.0474	580.5531	869.6412	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	938.1798	707.9811	570.1526	315.1901	143.8595	0.0000	0.0000	0.0000	0.0000	314.2118	642.2048	961.9925	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.0192	87.7207	87.1564	85.9798	83.9649	79.7000	79.7000	79.7000	79.7000	85.8770	87.4550	88.1106	(217)
Fuel for water heating, kWh/month													
	243.1086	214.8714	226.8046	205.6492	206.0330	193.4464	185.3060	203.9980	203.8445	213.5236	222.2599	236.8659	(219)
Water heating fuel used												2555.7111	(219)

Annual totals kWh/year		
Space heating fuel - main system	4593.7721	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	457.6163	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =	-1278.1572	-1278.1572 (233)
Total delivered energy for all uses	6403.9424	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4593.7721	3.4800	159.8633	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2555.7111	3.4800	88.9387	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	457.6163	13.1900	60.3596	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			270.4652	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.6718	(257)
SAP value	90.6283	
SAP rating (Section 12)	91	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4593.7721	0.2160	992.2548	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2555.7111	0.2160	552.0336	(264)
Space and water heating			1544.2884	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.6163	0.5190	237.5028	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			1157.3527	(272)
CO2 emissions per m2			9.3300	(273)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value	90.8282
EI rating	91 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8442 = 4.122, stars = 4
Water heating environmental impact	0.216 / 0.8442 = 0.2559, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	310.0149	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1613	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.4068	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4271	0.3966	0.4068	0.3864	0.3864	0.3763	0.3661	0.3559	0.3458	0.3763	0.3559	0.3763	(22b)
Effective ac	0.5912	0.5787	0.5827	0.5747	0.5747	0.5708	0.5670	0.5633	0.5598	0.5708	0.5633	0.5708	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			18.0000	1099.6200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16986.5980	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.8893	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.4844	59.1988	59.6168	58.7915	58.7915	58.3947	58.0085	57.6329	57.2679	58.3947	57.6329	58.3947	(38)
Heat transfer coeff	153.7757	152.4902	152.9081	152.0828	152.0828	151.6861	151.2999	150.9243	150.5593	151.6861	150.9243	151.6861	(39)
Average = Sum(39)m / 12 =												151.8421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2392	1.2289	1.2322	1.2256	1.2256	1.2224	1.2193	1.2162	1.2133	1.2224	1.2162	1.2224	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
								Total per year (kWh/year) = Sum(64)m =				2163.3212	(64)
Heat gains from water heating, kWh/month													
	92.9806	82.3906	87.5583	79.9188	79.3525	72.3911	70.9380	75.8915	75.1466	82.8013	85.7577	91.2256	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7803	57.5373	46.7925	35.4249	26.4805	22.3560	24.1564	31.3994	42.1443	53.5118	62.4562	66.5808	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.5021	438.0005	426.6647	402.5321	372.0690	343.4380	324.3108	319.8124	331.1482	355.2808	385.7439	414.3749	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	124.9739	122.6051	117.6859	110.9984	106.6566	100.5431	95.3468	102.0047	104.3702	111.2920	119.1079	122.6150	(72)
Total internal gains													
	738.9577	733.8442	706.8444	664.6567	620.9075	582.0385	559.5154	568.9178	593.3640	635.7860	683.0093	719.2719	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	13.4839	0.4600	0.0000	0.7700	11.4146	(74)
East	4.8600	25.1925	0.4600	0.0000	0.7700	43.3667	(76)
South	10.4500	56.7559	0.4600	0.0000	0.7700	210.0756	(78)
West	5.9900	25.1925	0.4600	0.0000	0.7700	53.4500	(80)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	348.0212	521.1194	755.0255	989.2055	1085.5405	1183.4844	1126.9613	1034.8273	881.7780	632.6882	419.2627	290.2466	(83)
Total gains	1086.9788	1254.9636	1461.8699	1653.8622	1706.4480	1765.5229	1686.4767	1603.7451	1475.1420	1268.4742	1102.2720	1009.5185	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.6843	30.9430	30.8584	31.0259	31.0259	31.1070	31.1864	31.2640	31.3398	31.1070	31.2640	31.1070	
alpha	3.0456	3.0629	3.0572	3.0684	3.0684	3.0738	3.0791	3.0843	3.0893	3.0738	3.0843	3.0738	
util living area													
	0.9526	0.9291	0.8745	0.7749	0.6418	0.4603	0.3408	0.3563	0.5728	0.8039	0.9196	0.9595	(86)
MIT	19.3447	19.5845	20.0071	20.4608	20.7722	20.9400	20.9823	20.9801	20.8801	20.4960	19.8857	19.3162	(87)
Th 2	19.8887	19.8970	19.8943	19.8996	19.8996	19.9021	19.9046	19.9070	19.9094	19.9021	19.9070	19.9021	(88)
util rest of house													
	0.9438	0.9164	0.8526	0.7371	0.5828	0.3813	0.2489	0.2609	0.4934	0.7607	0.9027	0.9517	(89)
MIT 2	17.7359	18.0810	18.6712	19.2871	19.6785	19.8600	19.8969	19.8983	19.8137	19.3531	18.5228	17.7044	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	18.0242	18.3505	18.9107	19.4974	19.8745	20.0535	20.0914	20.0922	20.0048	19.5579	18.7671	17.9933	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8742	18.2005	18.7607	19.3474	19.7245	19.9035	19.9414	19.9422	19.8548	19.4079	18.6171	17.8433	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9217	0.8911	0.8253	0.7156	0.5726	0.3814	0.2521	0.2641	0.4892	0.7379	0.8766	0.9314	(94)
Useful gains	1001.8571	1118.2768	1206.4548	1183.5055	977.0891	673.3330	425.1280	423.5476	721.5859	936.0676	966.2917	940.2873	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1995.1201	1967.2001	1798.3006	1497.6256	1098.7183	698.2918	429.9084	428.9525	776.1052	1214.6923	1617.4688	1948.1424	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

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

Space heating kWh													
	738.9876	570.4764	440.3333	226.1665	90.4921	0.0000	0.0000	0.0000	0.0000	207.2968	468.8475	749.8442	(98)
Space heating												3492.4444	(98)
Space heating per m2											(98) / (4) =	28.1444	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3863.3235	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	738.9876	570.4764	440.3333	226.1665	90.4921	0.0000	0.0000	0.0000	0.0000	207.2968	468.8475	749.8442	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	817.4642	631.0580	487.0944	250.1841	100.1019	0.0000	0.0000	0.0000	0.0000	229.3106	518.6366	829.4737	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating													
Water heating requirement													
	213.9823	188.4868	197.6747	176.8168	172.9955	154.1768	147.6889	162.5864	162.4641	183.3677	194.3773	208.7039	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.7546	87.4832	86.7899	85.3711	83.0771	79.7000	79.7000	79.7000	79.7000	85.0411	86.9777	87.8326	(217)
Fuel for water heating, kWh/month													
	243.8417	215.4549	227.7623	207.1155	208.2348	193.4464	185.3060	203.9980	203.8445	215.6224	223.4794	237.6156	(219)
Water heating fuel used												2565.7217	(219)
Annual totals kWh/year													
Space heating fuel - main system												3863.3235	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												457.6163	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												5531.2107	(238)

10a. Fuel costs - using BEDF prices (519)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3863.3235	9.7400	376.2877	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2565.7217	9.7400	249.9013	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	457.6163	36.8500	168.6316	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			399.3370	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3863.3235	0.2160	834.4779	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2565.7217	0.2160	554.1959	(264)
Space and water heating			1388.6738	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.6163	0.5190	237.5028	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			922.6976	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3863.3235	1.2200	4713.2547	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2565.7217	1.2200	3130.1805	(264)
Space and water heating			7843.4352	(265)

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

Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	457.6163	3.0700	1404.8820 (268)
Energy saving/generation technologies			
PV Unit	-1430.4508	3.0700	-4391.4840 (269)
Primary energy kWh/year			5087.0832 (272)
Primary energy kWh/m2/year			40.9951 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 115	-269 kg (29.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£115	2.17 kg/m²	A 92	A 93
Total Savings	£115	2.17 kg/m²		

Potential energy efficiency rating:	A 92
Potential environmental impact rating:	A 93

Fuel prices for cost data on this page from database revision number 519 TEST (31 May 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£196	£215	-£18
Mains gas	£730	£597	£133
Space heating	£508	£511	-£3
Water heating	£250	£132	£117
Lighting	£169	£169	£0
Generated (PV)	-£527	-£527	£0
Total cost of fuels	£399	£285	£115
Total cost of uses	£400	£285	£114
Delivered energy	45 kWh/m²	34 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.3 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	41 kWh/m²	29 kWh/m²	12 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		310.0149	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1613	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.4068	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5186	0.5085	0.4983	0.4475	0.4373	0.3864	0.3864	0.3763	0.4068	0.4373	0.4576	0.4780	(22b)
Effective ac	0.6345	0.6293	0.6242	0.6001	0.5956	0.5747	0.5747	0.5708	0.5827	0.5956	0.6047	0.6142	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			18.0000	1099.6200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16986.5980	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.8893	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	64.9122	64.3779	63.8542	61.3943	60.9340	58.7915	58.7915	58.3947	59.6168	60.9340	61.8651	62.8385	(38)
Heat transfer coeff	158.2036	157.6693	157.1455	154.6856	154.2254	152.0828	152.0828	151.6861	152.9081	154.2254	155.1564	156.1298	(39)
Average = Sum(39)m / 12 =												154.6834	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2749	1.2706	1.2664	1.2466	1.2429	1.2256	1.2256	1.2224	1.2322	1.2429	1.2504	1.2582	(40)
HLP (average)												1.2465	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4514	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7837	(55)
Total storage loss													
	24.2962	21.9449	24.2962	23.5124	24.2962	23.5124	24.2962	24.2962	23.5124	24.2962	23.5124	24.2962	(56)
If cylinder contains dedicated solar storage													
	14.7056	13.2824	14.7056	14.2312	14.7056	14.2312	14.7056	14.7056	14.2312	14.7056	14.2312	14.7056	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	205.2519	180.6012	187.5485	161.6144	151.4708	133.1213	125.9315	141.7595	148.6124	173.2415	185.9284	199.9735	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1240	(H8)
Utilisation factor												0.5892	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												102.5484	(H14)
Volume ratio Veff/V												1.0678	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-939.5962	(H17)
Solar input	-27.2464	-45.4664	-77.4345	-103.7776	-128.2084	-126.0493	-124.3835	-108.6745	-85.1139	-58.1228	-32.3182	-22.8006	(63)
								Solar input (sum of months) = Sum(63)m =				-939.5962	(63)
Output from w/h													
	178.0055	135.1348	110.1140	57.8368	23.2624	7.0720	1.5480	33.0851	63.4985	115.1188	153.6103	177.1729	(64)
								Total per year (kWh/year) = Sum(64)m =				1055.4588	(64)
Heat gains from water heating, kWh/month													
	85.9963	76.0822	79.4574	67.7569	62.1327	55.5466	53.5321	59.2300	64.0652	74.7003	78.9987	84.2412	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7803	57.5373	46.7925	35.4249	26.4805	22.3560	24.1564	31.3994	42.1443	53.5118	62.4562	66.5808	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.5021	438.0005	426.6647	402.5321	372.0690	343.4380	324.3108	319.8124	331.1482	355.2808	385.7439	414.3749	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	115.5864	113.2175	106.7976	94.1068	83.5117	77.1481	71.9518	79.6102	88.9795	100.4037	109.7203	113.2274	(72)
Total internal gains													
	729.5701	724.4567	695.9561	647.7652	597.7626	558.6434	536.1203	546.5233	577.9732	624.8976	673.6217	709.8844	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	10.6334	0.4600	0.0000	0.7700	9.0016	(74)
East	4.8600	19.6403	0.4600	0.0000	0.7700	33.8090	(76)
South	10.4500	46.7521	0.4600	0.0000	0.7700	173.0476	(78)
West	5.9900	19.6403	0.4600	0.0000	0.7700	41.6699	(80)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	280.6935	493.5791	708.0348	918.4552	1056.4468	1058.3550	1016.5881	913.9246	781.8699	555.1330	339.2229	238.1535	(83)
Total gains	1010.2637	1218.0358	1403.9909	1566.2204	1654.2094	1616.9984	1552.7084	1460.4479	1359.8432	1180.0306	1012.8447	948.0379	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	29.8255	29.9266	30.0263	30.5038	30.5948	31.0259	31.0259	31.1070	30.8584	30.5948	30.4112	30.2216	
alpha	2.9884	2.9951	3.0018	3.0336	3.0397	3.0684	3.0684	3.0738	3.0572	3.0397	3.0274	3.0148	
util living area													
	0.9643	0.9391	0.8952	0.8146	0.6965	0.5441	0.4118	0.4507	0.6514	0.8537	0.9435	0.9698	(86)
MIT	19.1021	19.4111	19.8345	20.3166	20.6761	20.8922	20.9657	20.9543	20.8050	20.3151	19.6240	19.0525	(87)
Th 2	19.8605	19.8639	19.8673	19.8829	19.8859	19.8996	19.8996	19.9021	19.8943	19.8859	19.8799	19.8737	(88)
util rest of house													
	0.9576	0.9281	0.8764	0.7818	0.6435	0.4671	0.3163	0.3532	0.5772	0.8199	0.9314	0.9641	(89)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.3700	17.8133	18.4136	19.0859	19.5531	19.8139	19.8815	19.8762	19.7238	19.1046	18.1356	17.3066	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	17.6804	18.0997	18.6683	19.3065	19.7544	20.0072	20.0758	20.0694	19.9176	19.3216	18.4024	17.6195	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5304	17.9497	18.5183	19.1565	19.6044	19.8572	19.9258	19.9194	19.7676	19.1716	18.2524	17.4695	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9379	0.9032	0.8483	0.7569	0.6288	0.4639	0.3186	0.3548	0.5678	0.7934	0.9073	0.9463	(94)
Useful gains	947.5634	1100.1520	1191.0619	1185.4804	1040.1125	750.1474	494.7630	518.2274	772.1446	936.2398	918.9873	897.1251	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2093.0975	2057.5293	1888.6152	1586.5299	1219.0525	799.5228	505.7959	533.8449	866.6194	1321.9543	1730.3613	2071.7696	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	852.2774	643.3575	518.9797	288.7557	133.1314	0.0000	0.0000	0.0000	0.0000	286.9716	584.1893	873.9355	(98)
Space heating												4181.5981	(98)
Space heating per m2											(98) / (4) =	33.6981	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4625.6616	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	852.2774	643.3575	518.9797	288.7557	133.1314	0.0000	0.0000	0.0000	0.0000	286.9716	584.1893	873.9355	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	942.7847	711.6786	574.0926	319.4200	147.2693	0.0000	0.0000	0.0000	0.0000	317.4465	646.2271	966.7428	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	178.0055	135.1348	110.1140	57.8368	23.2624	7.0720	1.5480	33.0851	63.4985	115.1188	153.6103	177.1729	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3507	88.3413	88.3244	88.4191	88.6301	79.7000	79.7000	79.7000	79.7000	87.0539	87.9419	88.3996	(217)
Fuel for water heating, kWh/month	201.4761	152.9690	124.6699	65.4121	26.2466	8.8733	1.9423	41.5120	79.6719	132.2384	174.6725	200.4228	(219)
Water heating fuel used												1210.1068	(219)

Annual totals kWh/year			
Space heating fuel - main system		4625.6616	(211)
Space heating fuel - secondary		0.0000	(215)
Electricity for pumps and fans:			
central heating pump		30.0000	(230c)
main heating flue fan		45.0000	(230e)
pump for solar water heating		50.0000	(230g)
Total electricity for the above, kWh/year		125.0000	(231)
Electricity for lighting (calculated in Appendix L)		457.6163	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =	-1278.1572	-1278.1572	(233)
Total delivered energy for all uses		5140.2276	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4625.6616	3.4800	160.9730	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1210.1068	3.4800	42.1117	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	457.6163	13.1900	60.3596	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			231.3429	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5746	(257)
SAP value		91.9839	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP rating (Section 12)	92	(258)
SAP band	A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4625.6616	0.2160	999.1429	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1210.1068	0.2160	261.3831	(264)
Space and water heating			1260.5260	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	457.6163	0.5190	237.5028	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			899.5403	(272)
CO2 emissions per m2			7.2500	(273)
EI value			92.8713	
EI rating			93	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.0000 (1b)	x	2.3900 (2b)	=	150.5700	(1b) - (3b)
First floor	61.0900 (1c)	x	2.6100 (2c)	=	159.4449	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		310.0149	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1613	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.4068	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4068	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4271	0.3966	0.4068	0.3864	0.3864	0.3763	0.3661	0.3559	0.3458	0.3763	0.3559	0.3763	(22b)
Effective ac	0.5912	0.5787	0.5827	0.5747	0.5747	0.5708	0.5670	0.5633	0.5598	0.5708	0.5633	0.5708	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0300	0.8000	1.6240			(26)
Half Glaze			2.0300	1.4000	2.8420			(26a)
Window (Uw = 1.30)			23.6900	1.2357	29.2747			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.50			63.0000	0.1200	7.5600	75.0000	4725.0000	(28a)
EW Brick AAC011	162.4600	31.0800	131.3800	0.2400	31.5312	42.1000	5531.0980	(29a)
PR 400mm MW044	61.0900		61.0900	0.1100	6.7199	9.0000	549.8100	(30)
PR 300mm MW044	1.9100		1.9100	0.1400	0.2674	9.0000	17.1900	(30)
Total net area of external elements Aum(A, m2)			288.4600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.9342			(33)
GF Masonry			62.3800			39.0000	2432.8200	(32c)
GF Timber			23.1800			9.0000	208.6200	(32c)
1F Timber			146.9800			9.0000	1322.8200	(32c)
Internal Floor			61.0900			18.0000	1099.6200	(32d)
Internal Ceiling			61.0900			18.0000	1099.6200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16986.5980	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.8893	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3571	(36)
Total fabric heat loss	(33) + (36) = 93.2913	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.4844	59.1988	59.6168	58.7915	58.7915	58.3947	58.0085	57.6329	57.2679	58.3947	57.6329	58.3947	(38)
Heat transfer coeff	153.7757	152.4902	152.9081	152.0828	152.0828	151.6861	151.2999	150.9243	150.5593	151.6861	150.9243	151.6861	(39)
Average = Sum(39)m / 12 =												151.8421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2392	1.2289	1.2322	1.2256	1.2256	1.2224	1.2193	1.2162	1.2133	1.2224	1.2162	1.2224	(40)
HLP (average)												1.2236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8778	(42)
Average daily hot water use (litres/day)	102.5484	(43)

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

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

	112.8032	108.7013	104.5993	100.4974	96.3955	92.2935	92.2935	96.3955	100.4974	104.5993	108.7013	112.8032	(44)
Energy conte	167.2839	146.3076	150.9763	131.6248	126.2971	108.9848	100.9905	115.8880	117.2721	136.6693	149.1853	162.0055	(45)
Energy content (annual)										Total = Sum(45)m =		1613.4852	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0926	21.9461	22.6464	19.7437	18.9446	16.3477	15.1486	17.3832	17.5908	20.5004	22.3778	24.3008	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4514	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7837	(55)
Total storage loss													
	24.2962	21.9449	24.2962	23.5124	24.2962	23.5124	24.2962	24.2962	23.5124	24.2962	23.5124	24.2962	(56)
If cylinder contains dedicated solar storage													
	14.7056	13.2824	14.7056	14.2312	14.7056	14.2312	14.7056	14.7056	14.2312	14.7056	14.2312	14.7056	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	205.2519	180.6012	187.5485	161.6144	151.4708	133.1213	125.9315	141.7595	148.6124	173.2415	185.9284	199.9735	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2580	(H8)
Utilisation factor												0.5484	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												102.5484	(H14)
Volume ratio Veff/V												1.0678	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-978.7128	(H17)
Solar input	-31.9280	-45.3996	-78.0309	-105.2818	-123.6598	-132.0882	-129.3103	-115.7367	-90.6138	-62.6473	-37.7624	-26.2541	(63)
								Solar input (sum of months) = Sum(63)m =				-978.7128	(63)
Output from w/h													
	173.3239	135.2017	109.5176	56.3326	27.8110	1.0331	0.0000	26.0229	57.9986	110.5943	148.1661	173.7194	(64)
								Total per year (kWh/year) = Sum(64)m =				1019.7210	(64)
Heat gains from water heating, kWh/month													
	85.9963	76.0822	79.4574	67.7569	62.1327	55.5466	53.5321	59.2300	64.0652	74.7003	78.9987	84.2412	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	172.6696	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7803	57.5373	46.7925	35.4249	26.4805	22.3560	24.1564	31.3994	42.1443	53.5118	62.4562	66.5808	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.5021	438.0005	426.6647	402.5321	372.0690	343.4380	324.3108	319.8124	331.1482	355.2808	385.7439	414.3749	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	55.1448	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	-115.1130	(71)
Water heating gains (Table 5)													
	115.5864	113.2175	106.7976	94.1068	83.5117	77.1481	71.9518	79.6102	88.9795	100.4037	109.7203	113.2274	(72)
Total internal gains													
	729.5701	724.4567	695.9561	647.7652	597.7626	558.6434	536.1203	546.5233	577.9732	624.8976	673.6217	709.8844	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3900	13.4839	0.4600	0.0000	0.7700	11.4146	(74)
East	4.8600	25.1925	0.4600	0.0000	0.7700	43.3667	(76)
South	10.4500	56.7559	0.4600	0.0000	0.7700	210.0756	(78)
West	5.9900	25.1925	0.4600	0.0000	0.7700	53.4500	(80)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	348.0212	521.1194	755.0255	989.2055	1085.5405	1183.4844	1126.9613	1034.8273	881.7780	632.6882	419.2627	290.2466	(83)
Total gains	1077.5913	1245.5761	1450.9815	1636.9707	1683.3031	1742.1278	1663.0817	1581.3506	1459.7512	1257.5858	1092.8845	1000.1309	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.6843	30.9430	30.8584	31.0259	31.0259	31.1070	31.1864	31.2640	31.3398	31.1070	31.2640	31.1070	
alpha	3.0456	3.0629	3.0572	3.0684	3.0684	3.0738	3.0791	3.0843	3.0893	3.0738	3.0843	3.0738	
util living area													
	0.9536	0.9303	0.8764	0.7786	0.6476	0.4655	0.3452	0.3609	0.5773	0.8068	0.9211	0.9604	(86)
MIT	19.3357	19.5762	19.9993	20.4527	20.7662	20.9381	20.9816	20.9794	20.8775	20.4901	19.8777	19.3069	(87)
Th 2	19.8887	19.8970	19.8943	19.8996	19.8996	19.9021	19.9046	19.9070	19.9094	19.9021	19.9070	19.9021	(88)
util rest of house													
	0.9449	0.9178	0.8547	0.7411	0.5886	0.3859	0.2523	0.2645	0.4977	0.7639	0.9045	0.9528	(89)

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

MIT 2	17.7230	18.0694	18.6607	19.2770	19.6722	19.8585	19.8966	19.8979	19.8114	19.3459	18.5118	17.6911	(90)
Living area fraction									fLA = Living area / (4) =			0.1792	(91)
MIT	18.0121	18.3395	18.9006	19.4877	19.8683	20.0520	20.0911	20.0918	20.0024	19.5510	18.7566	17.9807	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8621	18.1895	18.7506	19.3377	19.7183	19.9020	19.9411	19.9418	19.8524	19.4010	18.6066	17.8307	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9230	0.8926	0.8273	0.7193	0.5780	0.3859	0.2555	0.2677	0.4932	0.7409	0.8785	0.9327	(94)
Useful gains	994.6490	1111.7798	1200.4657	1177.4781	972.9931	672.2824	424.8879	423.2764	719.9854	931.8056	960.1154	932.8517	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1993.2491	1965.5173	1796.7621	1496.1498	1097.7771	698.0612	429.8532	428.8902	775.7470	1213.6360	1615.8801	1946.2358	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	742.9585	573.7116	443.6445	229.4436	92.8393	0.0000	0.0000	0.0000	0.0000	209.6818	472.1506	753.9578	(98)
Space heating												3518.3877	(98)
Space heating per m2											(98) / (4) =	28.3535	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3892.0218	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	742.9585	573.7116	443.6445	229.4436	92.8393	0.0000	0.0000	0.0000	0.0000	209.6818	472.1506	753.9578	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	821.8568	634.6367	490.7572	253.8093	102.6983	0.0000	0.0000	0.0000	0.0000	231.9489	522.2904	834.0241	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	173.3239	135.2017	109.5176	56.3326	27.8110	1.0331	0.0000	26.0229	57.9986	110.5943	148.1661	173.7194	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.1611	88.1431	88.0594	88.0693	87.6864	79.7000	79.7000	79.7000	79.7000	86.3948	87.5912	88.1830	(217)
Fuel for water heating, kWh/month	196.5990	153.3887	124.3679	63.9639	31.7164	1.2963	0.0000	32.6510	72.7711	128.0103	169.1563	196.9987	(219)
Water heating fuel used												1170.9198	(219)

Annual totals kWh/year		
Space heating fuel - main system	3892.0218	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	457.6163	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) = -1430.4508	-1430.4508	(233)
Total delivered energy for all uses	4215.1070	(238)

10a. Fuel costs - using BEDF prices (519)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3892.0218	9.7400	379.0829	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1170.9198	9.7400	114.0476	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	457.6163	36.8500	168.6316	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.8500	-527.1211	(252)
Total energy cost			284.7035	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3892.0218	0.2160	840.6767	(261)

Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1170.9198	0.2160	252.9187	(264)
Space and water heating			1093.5954	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	457.6163	0.5190	237.5028	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			653.5692	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3892.0218	1.2200	4748.2666	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1170.9198	1.2200	1428.5221	(264)
Space and water heating			6176.7887	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	457.6163	3.0700	1404.8820	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			3573.9366	(272)
Primary energy kWh/m2/year			28.8012	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	409.22	(P1)
Transmission heat loss coefficient	93.29	(37)
Summer heat loss coefficient	502.51	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.3900	87.1704	0.4600	0.0000	0.9000	86.2517
East	4.8600	125.2818	0.4600	0.0000	0.9000	252.0720
South	10.4500	118.5567	0.4600	0.0000	0.9000	512.9117
West	5.9900	125.2818	0.4600	0.0000	0.9000	310.6813
East	3.3300	125.2818	0.4600	0.0000	0.9000	172.7160
total:						1334.6326

	Jun	Jul	Aug	
Solar gains	1425	1335	1221	(P4)
Internal gains	579	557	566	
Total summer gains	2004	1891	1787	(P5)
Summer gain/loss ratio	3.99	3.76	3.56	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	20.43	22.11	21.90	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium