

ENERGY STATEMENT

PROPOSED DWELLING ADJACENT TO 11 TASMANIA
TERRACE, ENFIELD, LONDON, N18 1AX.

James Turner

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Executive Summary:

Below is the planning condition associated with this development:

Condition 12.

The development shall be implemented in accordance with an 'Energy Statement' to be submitted to and approved in writing by the Local Planning Authority. Submitted details will demonstrate the energy efficiency of the development and shall provide for no less than 35% improvement in the total Co2 emissions arising from the operation of the development and its services over Part L of Building Regs 2013. The development shall be carried out strictly in accordance with the details so approved and maintained as thereafter.

The proposed property is a 3 bedroomed end terrace property adjacent to 11 Tasmania Terrace.

The methodology used for the preparation of the Sap calculations, showing a minimum 35% reduction in regulated carbon emissions is outlined in the Advice Note on Carbon Reduction

Sap calculations, which achieve Part L (2013) compliance, were modelled to provide TER and DER figures for the proposed dwelling

Target Emission Rate = 24.95 KgCo2/year/m2
Dwelling Emission Rate = 9.65 KgCo2/year/m2

Percentage Reduction formula = $[1-(\text{DER}/\text{TER})] \times 100 = \text{at least } 35\%$

$[1-(9.65/24.95)] \times 100 = [1-0.387] \times 100 = 0.613 \times 100 = 61.32\%$

Total Savings in Co2 emissions DER v TER for the proposals

61.32%

Design Criteria for Reducing Carbon Emissions and Energy Consumption

Building Fabric

A highly insulated building with low U values and good levels of air tightness will help to limit heat losses through the fabric of the building.

Thermal bridges should be covered as a minimum by Accredited Construction Details and wherever possible by Enhanced Accredited Construction Details and manufacturers Constructive Details to enable losses through thermal bridging to be kept to a minimum.

Following energy efficiency measures, including the much better than minimum standard U values for the fabric of the building as below:

	Approved Document L Limiting fabric U Values	Proposed U values
External wall	0.26 W/m ² .k	0.17 W/m ² .k average
Roof	0.16 W/m ² .k	0.12 W/m ² .k average
Floor	0.18 W/m ² .k	0.12 W/m ² .k
Windows/glazed doors	1.60 W/m ² .k	1.20 – 1.40 W/m ² .k
Doors	1.60 W/m ² .k	1.00 W/m ² .k
Air permeability	8.0m ³ /hr/m ²	5.01m ³ /hr/m ²

Solar Gain

Careful positioning of glazed openings in the external fabric of the building can lead to increases in solar gain, which will contribute to lower energy consumption and reduced Co₂ emissions. Good daylight factors will also reduce energy consumption from artificial lighting. Openable windows/glazed doors, allowing a through flow a clean fresh air will also help to prevent summer overheating. If appropriate, internal shading (blinds, curtains etc) and external shading (shutters, sun shades etc) can also be used to limit summer overheating.

Low Energy Lighting

All lighting for the property should be low energy and bulbs should have a minimum of 75 lamp lumens per circuit watt. Fittings should also have more than 400 lumens per fitting. External low energy lighting, should be on PIR detectors to limit operation times.

Renewables

When considering appropriate technologies for providing an effective Energy Strategy for the proposed building, I have considered the nature of site, including its proximity to neighbouring properties.

The renewable technologies assessed with regards to this site are as follows:

Wind Turbine.

Combined heat and power

District Heating

Heat pumps (air source and ground source).

Biomass.

Solar Thermal.

Solar PV.

The use of a wind turbine is both impractical and not viable given the location of the proposed dwelling in a residential area.

The development is too small for a combined heat and power plant and there is no existing district heating scheme to connect in to.

The location and garden size of the property would limit the use of a ground source heat pump, which requires either a horizontal trench or a borehole for the coils. This also makes the use of a biomass boiler impractical as there is limited space for storage of fuels.

In terms of reducing Co2 emissions the use of fossil fuels, (mains gas, LPG and oil) are best avoided on this development.

For this reason, we have decided to use a highly efficient air source heat pump, combined with underfloor heating and radiators as the primary space heating source.

It is also proposed to install a solar PV system with a minimum of 1.2Kw on the rear flat roof, 0.9Kw on the side flat roof and 1.2Kw on the Northwest elevation roof.

It would be recommended that any installed solar PV system also be installed with a solar iboost system to feed excess generated electricity to the hot water cylinder immersion.

Conclusion

It is proposed that the development will achieve compliance with Condition 12, through the use of a high efficiency Air Source Heat Pump in tandem with solar PV panels. It should also be noted that the proposed dwelling has also been modelled with the latest Sap 10 version of building regulations and the property achieves compliance in all areas with regards to the building fabric (DFEE), the Co2 emissions (DER) and the primary energy rating (DPER).

Appendix 1: Sap 2013 Worksheets

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	7358-0001-TMG202001233			Issued on Date	15/02/2024
Assessment Reference	Proposed	Prop Type Ref			
Property	Proposed dwelling adjacent, 11 Tasmania Terrace, Enfield, London, , N18 1AX				
SAP Rating	92 A	DER	9.65	TER	24.95
Environmental	93 A	% DER<TER	61.32		
CO ₂ Emissions (t/year)	0.55	DFEE	46.41	TFEE	57.38
General Requirements Compliance	Pass	% DFEE<TFEE	19.12		
Assessor Details	Mr. James Turner, J E Turner, Tel: 01437710954, jim.thinkinggreen@gmail.com			Assessor ID	7358-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 119 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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 24.95 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.65 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)57.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.18 (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	0.12 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.90 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing South East: 17.27 m², No overhang
Windows facing North West: 11.20 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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 1.00 W/m²K
Photovoltaic array 3.30 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					3 * 10 = 30.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) = 0.0993 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3493 (18)							
Number of sides sheltered					1 (19)							
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)							
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3231 (21)							
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
Effective ac	0.4120	0.4039	0.3958	0.3554	0.3474	0.3070	0.3070	0.2989	0.3231	0.3474	0.3635	0.3797 (22b)
	0.5849	0.5816	0.5783	0.5632	0.5603	0.5471	0.5471	0.5447	0.5522	0.5603	0.5661	0.5721 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			18.0000	674.2800 (32e)					
Internal Ceiling 2			21.2800			18.0000	383.0400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 31393.6275 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							263.0824 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	58.2981	57.9697	57.6477	56.1354	55.8525	54.5353	54.5353	54.2914	55.0427	55.8525	56.4248	57.0233 (38)
Average = Sum(39)m / 12 =	145.3706	145.0421	144.7202	143.2079	142.9250	141.6078	141.6078	141.3639	142.1151	142.9250	143.4973	144.0957 (39)
												143.2065 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2182	1.2155	1.2128	1.2001	1.1977	1.1867	1.1867	1.1846	1.1909	1.1977	1.2025	1.2075 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8607 (42)
Average daily hot water use (litres/day)												102.1413 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555 (44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9930	21.8590	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0260 (55)
Total storage loss												
31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060 (56)
If cylinder contains dedicated solar storage												
31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060 (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	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309 (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)
Output from w/h	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309 (64)
Heat gains from water heating, kWh/month	99.4558	88.2455	94.0551	86.2251	85.8818	78.7272	77.5008	82.4345	81.4718	89.3169	92.0408	97.7078 (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	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.3490	22.5147	18.3102	13.8620	10.3620	8.7480	9.4526	12.2868	16.4913	20.9395	24.4395	26.0535 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	284.3384	287.2889	279.8536	264.0248	244.0438	225.2644	212.7187	209.7681	217.2034	233.0322	253.0132	271.7926 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034 (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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275 (71)
Water heating gains (Table 5)	133.6772	131.3178	126.4181	119.7571	115.4326	109.3434	104.1677	110.7991	113.1553	120.0496	127.8345	131.3276 (72)
Total internal gains	512.2749	510.0317	493.4923	466.5543	438.7487	412.2662	395.2493	401.7644	415.7603	442.9317	474.1976	498.0841 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Southeast	12.1800	36.7938	0.6300	0.7000	0.7700	136.9601 (77)						
Southeast	5.0900	36.7938	0.6300	0.7000	0.7700	57.2354 (77)						
Northwest	11.2000	11.2829	0.6300	0.7000	0.7700	38.6200 (81)						
Northwest	2.0200	16.3666	0.6300	0.7000	1.0000	13.1217 (82)						
Horizontal	0.3600	26.0000	0.6300	0.7000	1.0000	3.7150 (82)						
Solar gains	249.6522	444.1209	657.7587	898.9072	1083.4051	1109.2342	1055.4116	912.6279	740.4630	504.3577	302.4631	211.4256 (83)
Total gains	761.9271	954.1527	1151.2510	1365.4615	1522.1538	1521.5004	1450.6608	1314.3922	1156.2233	947.2893	776.6607	709.5097 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	59.9877	60.1236	60.2573	60.8937	61.0142	61.5817	61.5817	61.6880	61.3619	61.0142	60.7708	60.5185
alpha	4.9992	5.0082	5.0172	5.0596	5.0676	5.1054	5.1054	5.1125	5.0908	5.0676	5.0514	5.0346
util living area	0.9979	0.9933	0.9772	0.9169	0.7739	0.5778	0.4262	0.4878	0.7602	0.9604	0.9948	0.9985 (86)
MIT	20.0118	20.1683	20.4001	20.6762	20.8614	20.9315	20.9441	20.9418	20.8895	20.6223	20.2599	19.9852 (87)
Th 2	19.9054	19.9076	19.9098	19.9199	19.9218	19.9307	19.9307	19.9323	19.9273	19.9218	19.9180	19.9140 (88)
util rest of house	0.9972	0.9909	0.9690	0.8891	0.7121	0.4891	0.3244	0.3782	0.6735	0.9413	0.9925	0.9980 (89)
MIT 2	18.5881	18.8177	19.1531	19.5417	19.7683	19.8439	19.8519	19.8527	19.8084	19.4806	18.9603	18.5559 (90)
Living area fraction												fLA = Living area / (4) = 0.2338 (91)
MIT	18.9210	19.1334	19.4446	19.8069	20.0239	20.0982	20.1073	20.1073	20.0612	19.7475	19.2642	18.8901 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9210	19.1334	19.4446	19.8069	20.0239	20.0982	20.1073	20.1073	20.0612	19.7475	19.2642	18.8901 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9962	0.9886	0.9646	0.8857	0.7185	0.5034	0.3414	0.3965	0.6854	0.9373	0.9906	0.9973 (94)
Useful gains	759.0249	943.2937	1110.5019	1209.3240	1093.6180	765.9462	495.2870	521.2101	792.4513	887.8999	769.3952	707.5854 (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	2125.4583	2064.4495	1873.3481	1561.9555	1189.6924	778.5877	496.6612	524.0842	847.1707	1307.4072	1745.5255	2116.7793 (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	1016.6265	753.4166	567.5576	253.8947	71.4794	0.0000	0.0000	0.0000	0.0000	312.1134	702.8139	1048.4402 (98)
Space heating												4726.3422 (98)
Space heating per m2												(98) / (4) = 39.6073 (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 %)												175.1000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2699.2246 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1016.6265	753.4166	567.5576	253.8947	71.4794	0.0000	0.0000	0.0000	0.0000	312.1134	702.8139	1048.4402 (98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000 (210)
Space heating fuel (main heating system)	580.5976	430.2779	324.1334	144.9998	40.8220	0.0000	0.0000	0.0000	0.0000	178.2487	401.3786	598.7665 (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 requirement	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309 (64)
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	126.6067	111.6311	117.3304	105.3080	103.2920	92.4296	88.8966	97.3709	97.1437	109.1920	115.2970	123.6042 (219)
Water heating fuel used												1288.1023 (219)
Annual totals kWh/year												
Space heating fuel - main system												2699.2246 (211)
Space heating fuel - secondary												0.0000 (215)

Electricity for pumps and fans:

central heating pump												30.0000 (230c)
Total electricity for the above, kWh/year												30.0000 (231)
Electricity for lighting (calculated in Appendix L)												447.6708 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 1.20 * 951 * 1.00) =												-912.5914	-2246.4795
PV Unit 1 (0.80 * 1.20 * 677 * 1.00) =												-649.4447	-2246.4795
PV Unit 2 (0.80 * 0.90 * 951 * 1.00) =												-684.4435	-2246.4795 (233)
Total delivered energy for all uses													2218.5181 (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	2699.2246	0.5190	1400.8976 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1288.1023	0.5190	668.5251 (264)
Space and water heating			2069.4226 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	447.6708	0.5190	232.3411 (268)
Energy saving/generation technologies			
PV Unit	-2246.4795	0.5190	-1165.9229 (269)
Total CO2, kg/year			1151.4109 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.6500 (273)

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

DER			9.6500 ZC1
Total Floor Area		TFA	119.3300
Assumed number of occupants		N	2.8607
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			14.1199 ZC2
CO2 emissions from cooking, equation (L16)			1.5726 ZC3
Total CO2 emissions			25.3425 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			25.3425 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1324 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3824 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3537 (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	0.4510	0.4422	0.4333	0.3891	0.3803	0.3361	0.3361	0.3272	0.3537	0.3803	0.3980	0.4156 (22b)
Effective ac	0.6017	0.5978	0.5939	0.5757	0.5723	0.5565	0.5565	0.5535	0.5626	0.5723	0.5792	0.5864 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			1.9700	1.0000	1.9700		(26)
TER Opening Type (Uw = 1.40)			25.7200	1.3258	34.0985		(27)
TER Room Window (Uw = 1.70)			2.1500	1.5918	3.4223		(27a)
Heat Loss Floor 1			60.5900	0.1300	7.8767		(28a)
Cavity wall	110.9800	23.7100	87.2700	0.1800	15.7086		(29a)
Stud to eaves	7.7500		7.7500	0.1800	1.3950		(29a)
Dormer walls	27.3200	3.9800	23.3400	0.1800	4.2012		(29a)
Eaves void	16.1800		16.1800	0.1300	2.1034		(30)
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069		(30)
Dormer flat roof	15.4100	0.3300	15.0800	0.1300	1.9604		(30)
Sloping ceiling	7.3300	1.8200	5.5100	0.1300	0.7163		(30)
Total net area of external elements Aum(A, m ²)			268.6900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 76.4593		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.8319 (36)
Total fabric heat loss							(33) + (36) = 92.2912 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	59.9775	59.5838	59.1979	57.3854	57.0463	55.4677	55.4677	55.1753	56.0757	57.0463	57.7323	58.4495 (38)
Average = Sum(39)m / 12 =	152.2687	151.8750	151.4891	149.6766	149.3375	147.7588	147.7588	147.4665	148.3669	149.3375	150.0235	150.7407 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2760	1.2727	1.2695	1.2543	1.2515	1.2382	1.2382	1.2358	1.2433	1.2515	1.2572	1.2632 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8607 (42)
Average daily hot water use (litres/day)												102.1413 (43)
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555 (44)
Energy conte	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1607.0811 (45)
Distribution loss (46)m = 0.15 x (45)m														
	24.9930	21.8590	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044	(46)	
Water storage loss:														
Store volume													210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7016	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)	
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	218.3665	192.4657	202.1237	181.1797	177.5424	158.6296	152.3362	167.1746	166.8840	187.8735	198.6705	213.1091	(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)	
Output from w/h	218.3665	192.4657	202.1237	181.1797	177.5424	158.6296	152.3362	167.1746	166.8840	187.8735	198.6705	213.1091	(64)	
Heat gains from water heating, kWh/month	96.7984	85.8453	91.3976	83.6534	83.2244	76.1555	74.8433	79.7771	78.9001	86.6595	89.4691	95.0503	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.3490	22.5147	18.3102	13.8620	10.3620	8.7480	9.4526	12.2868	16.4913	20.9395	24.4395	26.0535	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	284.3384	287.2889	279.8536	264.0248	244.0438	225.2644	212.7187	209.7681	217.2034	233.0322	253.0132	271.7926	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	(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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	(71)
Water heating gains (Table 5)	130.1054	127.7459	122.8463	116.1853	111.8607	105.7715	100.5959	107.2273	109.5834	116.4778	124.2626	127.7558	(72)
Total internal gains	508.7030	506.4599	489.9205	462.9824	435.1769	408.6943	391.6774	398.1926	412.1885	439.3598	470.6257	494.5122	(73)

6. Solar gains

[Jan]			Area	Solar flux	g	Specific data	FF	Access	Gains				
			m2	Table 6a	W/m2	or Table 6b	Specific data	factor	W				
						or Table 6c	Table 6d						
Southeast			15.6000	36.7938	0.6300		0.7000	0.7700	175.4169 (77)				
Northwest			10.1200	11.2829	0.6300		0.7000	0.7700	34.8959 (81)				
Northwest			1.8200	16.3666	0.6300		0.7000	1.0000	11.8225 (82)				
Horizontal			0.3300	26.0000	0.6300		0.7000	1.0000	3.4054 (82)				
Solar gains	225.5408	401.2367	594.2604	812.1386	978.8257	1002.1582	953.5327	824.5350	668.9851	455.6618	273.2530	191.0048	(83)
Total gains	734.2438	907.6966	1084.1809	1275.1210	1414.0026	1410.8525	1345.2101	1222.7275	1081.1736	895.0216	743.8788	685.5170	(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	54.4223	54.5633	54.7023	55.3647	55.4905	56.0833	56.0833	56.1945	55.8535	55.4905	55.2367	54.9739	
alpha	4.6282	4.6376	4.6468	4.6910	4.6994	4.7389	4.7389	4.7463	4.7236	4.6994	4.6824	4.6649	
util living area	0.9977	0.9936	0.9806	0.9340	0.8171	0.6334	0.4752	0.5392	0.8020	0.9668	0.9948	0.9984 (86)	
MIT	19.6072	19.8120	20.1270	20.5210	20.8196	20.9597	20.9916	20.9852	20.8788	20.4685	19.9615	19.5749 (87)	
Th 2	19.8597	19.8623	19.8648	19.8768	19.8790	19.8895	19.8895	19.8915	19.8855	19.8790	19.8745	19.8698 (88)	
util rest of house	0.9969	0.9914	0.9737	0.9107	0.7593	0.5384	0.3595	0.4170	0.7189	0.9505	0.9927	0.9978 (89)	
MIT 2	18.0147	18.3148	18.7717	19.3319	19.7118	19.8646	19.8867	19.8859	19.7935	19.2736	18.5426	17.9745 (90)	
Living area fraction	fLA = Living area / (4) =												
MIT	18.3871	18.6648	19.0886	19.6099	19.9708	20.1206	20.1450	20.1429	20.0473	19.5529	18.8743	18.3487 (92)	
Temperature adjustment													0.0000
adjusted MIT	18.3871	18.6648	19.0886	19.6099	19.9708	20.1206	20.1450	20.1429	20.0473	19.5529	18.8743	18.3487 (93)	

8. Space heating requirement

Utilisation	0.9954	0.9881	0.9674	0.9040	0.7646	0.5592	0.3867	0.4457	0.7325	0.9442	0.9898	0.9966 (94)
Useful gains	730.8547	896.8747	1048.8069	1152.6806	1081.1432	788.9175	520.1291	544.9345	791.9875	845.0753	736.3175	683.1790 (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	2145.0174	2090.5329	1907.0301	1603.0238	1235.1432	815.7242	523.8082	551.9517	882.3794	1337.0084	1766.4247	2132.7827 (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	1052.1371	802.1383	638.5181	324.2472	114.5760	0.0000	0.0000	0.0000	0.0000	365.9983	741.6772	1078.5052 (98)
Space heating												5117.7972 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2 (98) / (4) = 42.8878 (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 5473.5798 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1052.1371	802.1383	638.5181	324.2472	114.5760	0.0000	0.0000	0.0000	0.0000	365.9983	741.6772	1078.5052	(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)	1125.2803	857.9019	682.9070	346.7884	122.5412	0.0000	0.0000	0.0000	0.0000	391.4420	793.2376	1153.4815	(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 requirement	218.3665	192.4657	202.1237	181.1797	177.5424	158.6296	152.3362	167.1746	166.8840	187.8735	198.6705	213.1091	(64)
Efficiency of water heater (217)m	88.4613	88.2112	87.6735	86.3496	83.6806	79.8000	79.8000	79.8000	79.8000	86.5630	88.0069	79.8000	(216)
Fuel for water heating, kWh/month	246.8497	218.1874	230.5414	209.8212	212.1669	198.7840	190.8975	209.4920	209.1278	217.0368	225.7442	240.6893	(219)
Water heating fuel used												2609.3381	(219)
Annual totals kWh/year													
Space heating fuel - main system												5473.5798	(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) 447.6708 (232)
 Total delivered energy for all uses 8605.5887 (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	5473.5798	0.2160	1182.2932 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2609.3381	0.2160	563.6170 (264)
Space and water heating			1745.9103 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	447.6708	0.5190	232.3411 (268)
Total CO2, kg/m2/year			2017.1764 (272)
Emissions per m2 for space and water heating			14.6309 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			1.9470 (272b)
Emissions per m2 for pumps and fans			0.3262 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6309 * 1.55) + 1.9470 + 0.3262, rounded to 2 d.p.			24.9500 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	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)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.1324 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3824 (18)							
Number of sides sheltered					1 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3537 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.4510	0.4422	0.4333	0.3891	0.3803	0.3361	0.3361	0.3272	0.3537	0.3803	0.3980	0.4156 (22b)
Effective ac	0.6017	0.5978	0.5939	0.5757	0.5723	0.5565	0.5565	0.5535	0.5626	0.5723	0.5792	0.5864 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			9.0000	337.1400 (32e)					
Internal Ceiling 2			21.2800			9.0000	191.5200 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 30864.9675 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							258.6522 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 59.9775	Feb 59.5838	Mar 59.1979	Apr 57.3854	May 57.0463	Jun 55.4677	Jul 55.4677	Aug 55.1753	Sep 56.0757	Oct 57.0463	Nov 57.7323	Dec 58.4495 (38)
Heat transfer coeff	147.0500	146.6563	146.2704	144.4579	144.1188	142.5401	142.5401	142.2478	143.1482	144.1188	144.8048	145.5220 (39)
Average = Sum(39)m / 12 =												144.4563 (39)
HLP	Jan 1.2323	Feb 1.2290	Mar 1.2258	Apr 1.2106	May 1.2077	Jun 1.1945	Jul 1.1945	Aug 1.1921	Sep 1.1996	Oct 1.2077	Nov 1.2135	Dec 1.2195 (40)
HLP (average)												1.2106 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8607 (42)
Average daily hot water use (litres/day)												102.1413 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555 (44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625 (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	35.4067	30.9670	31.9551	27.8593	26.7316	23.0674	21.3753	24.5285	24.8214	28.9270	31.5760	34.2895 (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	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344	143.0344 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.3490	22.5147	18.3102	13.8620	10.3620	8.7480	9.4526	12.2868	16.4913	20.9395	24.4395	26.0535 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	284.3384	287.2889	279.8536	264.0248	244.0438	225.2644	212.7187	209.7681	217.2034	233.0322	253.0132	271.7926 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034	37.3034 (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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275 (71)
Water heating gains (Table 5)	47.5897	46.0818	42.9504	38.6934	35.9296	32.0380	28.7302	32.9684	34.4742	38.8803	43.8556	46.0881 (72)
Total internal gains	423.1874	421.7957	407.0246	382.4906	356.2457	331.9608	316.8118	320.9336	334.0792	358.7624	387.2187	409.8445 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Southeast	12.1800	36.7938	0.6300	0.7000	0.7700	136.9601 (77)						
Southeast	5.0900	36.7938	0.6300	0.7000	0.7700	57.2354 (77)						
Northwest	11.2000	11.2829	0.6300	0.7000	0.7700	38.6200 (81)						
Northwest	2.0200	16.3666	0.6300	0.7000	1.0000	13.1217 (82)						
Horizontal	0.3600	26.0000	0.6300	0.7000	1.0000	3.7150 (82)						
Solar gains	249.6522	444.1209	657.7587	898.9072	1083.4051	1109.2342	1055.4116	912.6279	740.4630	504.3577	302.4631	211.4256 (83)
Total gains	672.8396	865.9167	1064.7833	1281.3978	1439.6508	1441.1950	1372.2234	1233.5615	1074.5422	863.1201	689.6818	621.2701 (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	58.3040	58.4605	58.6147	59.3502	59.4898	60.1487	60.1487	60.2723	59.8932	59.4898	59.2080	58.9162
alpha	4.8869	4.8974	4.9076	4.9567	4.9660	5.0099	5.0099	5.0182	4.9929	4.9660	4.9472	4.9277
util living area	0.9987	0.9953	0.9828	0.9320	0.8013	0.6079	0.4521	0.5199	0.7962	0.9716	0.9967	0.9991 (86)
MIT	19.6532	19.8673	20.1878	20.5804	20.8584	20.9725	20.9948	20.9901	20.8996	20.4993	19.9960	19.6197 (87)
Th 2	19.8942	19.8969	19.8994	19.9115	19.9138	19.9244	19.9244	19.9264	19.9203	19.9138	19.9092	19.9044 (88)
util rest of house	0.9982	0.9937	0.9765	0.9081	0.7420	0.5164	0.3442	0.4040	0.7129	0.9571	0.9953	0.9988 (89)
MIT 2	18.6699	18.8853	19.2039	19.5878	19.8262	19.9132	19.9233	19.9239	19.8693	19.5224	19.0241	18.6446 (90)
Living area fraction												fLA = Living area / (4) = 0.2338 (91)
MIT	18.8998	19.1149	19.4339	19.8199	20.0675	20.1608	20.1738	20.1732	20.1102	19.7508	19.2513	18.8726 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8998	19.1149	19.4339	19.8199	20.0675	20.1608	20.1738	20.1732	20.1102	19.7508	19.2513	18.8726 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	671.2453	859.0281	1036.0987	1160.5243	1081.4275	774.2948	507.1670	532.0354	783.5698	823.6417	685.5899	620.2651 (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	2146.9044	2084.7052	1891.8482	1577.4643	1205.9166	792.6441	509.4089	536.7238	860.3502	1318.8002	1759.5720	2135.1830 (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	1097.8904	823.6550	636.6776	300.1968	92.6199	0.0000	0.0000	0.0000	0.0000	368.3979	773.2671	1127.0990 (98)
Space heating												5219.8036 (98)
Space heating per m ²												(98) / (4) = 43.7426 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1339.8773	1054.7971	1081.0833	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9263	0.9625	0.9423	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1241.0991	1015.2301	1018.6721	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1773.1548	1691.6508	1536.6290	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	383.0801	503.2570	385.3599	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												1271.6971 (104)
Intermittency factor (Table 10b)												fc = cooled area / (4) = 1.0000 (105)
Space cooling kWh	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												317.9243 (107)
Space cooling per m2												2.6642 (108)
Energy for space heating												43.7426 (99)
Energy for space cooling												2.6642 (108)
Total												46.4068 (109)
Dwelling Fabric Energy Efficiency (DFEE)												46.4 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2d)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.1324 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3824 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3537 (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	0.4510	0.4422	0.4333	0.3891	0.3803	0.3361	0.3361	0.3272	0.3537	0.3803	0.3980	0.4156 (22b)
Effective ac	0.6017	0.5978	0.5939	0.5757	0.5723	0.5565	0.5565	0.5535	0.5626	0.5723	0.5792	0.5864 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			1.9700	1.0000	1.9700		(26)
TER Opening Type (Uw = 1.40)			25.7200	1.3258	34.0985		(27)
TER Room Window (Uw = 1.70)			2.1500	1.5918	3.4223		(27a)
Heat Loss Floor 1			60.5900	0.1300	7.8767		(28a)
Cavity wall	110.9800	23.7100	87.2700	0.1800	15.7086		(29a)
Stud to eaves	7.7500		7.7500	0.1800	1.3950		(29a)
Dormer walls	27.3200	3.9800	23.3400	0.1800	4.2012		(29a)
Eaves void	16.1800		16.1800	0.1300	2.1034		(30)
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069		(30)
Dormer flat roof	15.4100	0.3300	15.0800	0.1300	1.9604		(30)
Sloping ceiling	7.3300	1.8200	5.5100	0.1300	0.7163		(30)
Total net area of external elements Aum(A, m ²)			268.6900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 76.4593		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.8319 (36)
Total fabric heat loss							(33) + (36) = 92.2912 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	59.9775	59.5838	59.1979	57.3854	57.0463	55.4677	55.4677	55.1753	56.0757	57.0463	57.7323	58.4495 (38)
Average = Sum(39)m / 12 =	152.2687	151.8750	151.4891	149.6766	149.3375	147.7588	147.7588	147.4665	148.3669	149.3375	150.0235	150.7407 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2760	1.2727	1.2695	1.2543	1.2515	1.2382	1.2382	1.2358	1.2433	1.2515	1.2572	1.2632 (40)
HLP (average)												1.2543 (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 2.8607 (42)

Average daily hot water use (litres/day) 102.1413 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555 (44)
Energy conte	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1388.9329	1093.4153	1120.7452	0.0000	0.0000	0.0000	0.0000	(100)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8887	0.9381	0.9107	0.0000	0.0000	0.0000	0.0000	(101)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1234.3147	1025.7657	1020.7181	0.0000	0.0000	0.0000	0.0000	(102)	
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1650.4715	1574.8802	1435.4940	0.0000	0.0000	0.0000	0.0000	(103)	
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	299.6329	408.5411	308.5933	0.0000	0.0000	0.0000	0.0000	(104)	
Cooled fraction												1016.7674	(104)	
Intermittency factor (Table 10b)												FC = cooled area / (4) =	1.0000	(105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	74.9082	102.1353	77.1483	0.0000	0.0000	0.0000	0.0000	(107)	
Space cooling per m2												254.1918	(107)	
Energy for space heating												2.1302	(108)	
Energy for space cooling												47.7638	(99)	
Total												2.1302	(108)	
Target Fabric Energy Efficiency (TFEE)												49.8939	(109)	
												57.4	(109)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2d)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					3 * 10 = 30.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 30.0000 / (5) = 0.0993 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3493 (18)							
Number of sides sheltered					1 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3231 (21)							
Wind speed	Jan 4.2000	Feb 3.9000	Mar 4.0000	Apr 3.7000	May 3.8000	Jun 3.2000	Jul 3.3000	Aug 3.6000	Sep 3.4000	Oct 3.6000	Nov 3.5000	Dec 3.9000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9250	0.9500	0.8000	0.8250	0.9000	0.8500	0.9000	0.8750	0.9750 (22a)
Adj infilt rate	0.3393	0.3150	0.3231	0.2989	0.3070	0.2585	0.2666	0.2908	0.2747	0.2908	0.2827	0.3150 (22b)
Effective ac	0.5576	0.5496	0.5522	0.5447	0.5471	0.5334	0.5355	0.5423	0.5377	0.5423	0.5400	0.5496 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			18.0000	674.2800 (32e)					
Internal Ceiling 2			21.2800			18.0000	383.0400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 31393.6275 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							263.0824 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 55.5760	Feb 54.7857	Mar 55.0427	Apr 54.2914	May 54.5353	Jun 53.1694	Jul 53.3808	Aug 54.0540	Sep 53.5987	Oct 54.0540	Nov 53.8231	Dec 54.7857 (38)
Heat transfer coeff	142.6485	141.8582	142.1151	141.3639	141.6078	140.2419	140.4533	141.1265	140.6712	141.1265	140.8956	141.8582 (39)
Average = Sum(39)m / 12 =												141.3306 (39)
HLP	Jan 1.1954	Feb 1.1888	Mar 1.1909	Apr 1.1846	May 1.1867	Jun 1.1752	Jul 1.1770	Aug 1.1827	Sep 1.1788	Oct 1.1827	Nov 1.1807	Dec 1.1888 (40)
HLP (average)												1.1844 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8607 (42)
Average daily hot water use (litres/day)													102.1413 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555	(44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625	(45)
Energy content (annual)													Total = Sum(45)m = 1607.0811 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9930	21.8590	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0260 (55)
Total storage loss													
	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)
If cylinder contains dedicated solar storage													
	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(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	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(64)
Total per year (kWh/year) = Sum(64)m =													2255.4671 (64)
RHI water heating demand													2255 (64)
Heat gains from water heating, kWh/month	99.4558	88.2455	94.0551	86.2251	85.8818	78.7272	77.5008	82.4345	81.4718	89.3169	92.0408	97.7078	(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	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.3724	56.2868	45.7755	34.6550	25.9050	21.8701	23.6314	30.7170	41.2283	52.3488	61.0988	65.1337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.3856	428.7894	417.6920	394.0669	364.2445	336.2156	317.4906	313.0868	324.1842	347.8093	377.6317	405.6606	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	(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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	(71)
Water heating gains (Table 5)	133.6772	131.3178	126.4181	119.7571	115.4326	109.3434	104.1677	110.7991	113.1553	120.0496	127.8345	131.3276	(72)
Total internal gains	736.6738	731.6326	705.1242	663.7176	620.8207	582.6676	560.5283	569.8415	593.8064	635.4463	681.8036	717.3606	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Southeast	12.1800	40.4699	0.6300	0.7000	0.7700	150.6438 (77)							
Southeast	5.0900	40.4699	0.6300	0.7000	0.7700	62.9538 (77)							
Northwest	11.2000	12.9236	0.6300	0.7000	0.7700	44.2356 (81)							
Northwest	2.0200	18.7850	0.6300	0.7000	1.0000	15.0607 (82)							
Horizontal	0.3600	30.0000	0.6300	0.7000	1.0000	4.2865 (82)							
Solar gains	277.1804	428.9502	647.3041	914.3800	1074.3119	1191.1753	1136.9650	999.0369	806.1546	540.2767	344.2556	232.3419	(83)
Total gains	1013.8543	1160.5828	1352.4283	1578.0976	1695.1325	1773.8429	1697.4933	1568.8784	1399.9610	1175.7230	1026.0591	949.7025	(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	61.1324	61.4730	61.3619	61.6880	61.5817	62.1815	62.0879	61.7918	61.9918	61.7918	61.8930	61.4730	(86)
alpha	5.0755	5.0982	5.0908	5.1125	5.1054	5.1454	5.1392	5.1195	5.1328	5.1195	5.1262	5.0982	(87)
util living area	0.9896	0.9788	0.9356	0.8098	0.6037	0.3469	0.1985	0.2338	0.5134	0.8586	0.9737	0.9921	(88)
MIT	20.2673	20.3883	20.6191	20.8306	20.9250	20.9462	20.9471	20.9469	20.9399	20.8160	20.5094	20.2393	(89)
Th 2	19.9237	19.9290	19.9273	19.9323	19.9307	19.9399	19.9384	19.9339	19.9370	19.9339	19.9355	19.9290	(90)
util rest of house	0.9858	0.9715	0.9143	0.7588	0.5265	0.2638	0.1107	0.1380	0.4130	0.8040	0.9629	0.9892	(91)
MIT 2	18.9739	19.1514	19.4712	19.7424	19.8379	19.8623	19.8611	19.8562	19.8564	19.7355	19.3316	18.9378	(92)
Living area fraction													fLA = Living area / (4) = 0.2338 (91)
MIT	19.2763	19.4406	19.7396	19.9968	20.0921	20.1157	20.1150	20.1112	20.1097	19.9882	19.6070	19.2421	(92)
Temperature adjustment													0.0000
adjusted MIT	19.2763	19.4406	19.7396	19.9968	20.0921	20.1157	20.1150	20.1112	20.1097	19.9882	19.6070	19.2421	(93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9829	0.9673	0.9099	0.7622	0.5386	0.2777	0.1254	0.1539	0.4297	0.8072	0.9586	0.9867 (94)
Useful gains	996.4787	1122.5991	1230.5420	1202.8254	913.0057	492.5599	212.7811	241.4856	601.5418	948.9948	983.6067	937.0920 (95)
Ext temp.	5.5000	6.0000	8.0000	10.5000	13.5000	16.6000	18.6000	18.4000	15.8000	12.2000	8.4000	5.5000 (96)
Heat loss rate W												
Month fracti	1965.1703	1906.6581	1668.3731	1342.5085	933.4884	493.0504	212.7854	241.4997	606.2537	1099.1145	1579.0170	1949.4314 (97)
Space heating kWh	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	720.7066	526.8876	325.7463	100.5718	15.2392	0.0000	0.0000	0.0000	0.0000	111.6891	428.6954	753.1805 (98)
RHI space heating demand												2982.7165 (98)
												2983 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					3 * 10 = 30.0000 (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) =					30.0000 / (5) = 0.0993 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3493 (18)							
Number of sides sheltered					1 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3231 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.4120	0.4039	0.3958	0.3554	0.3474	0.3070	0.3070	0.2989	0.3231	0.3474	0.3635	0.3797 (22b)
Effective ac	0.5849	0.5816	0.5783	0.5632	0.5603	0.5471	0.5471	0.5447	0.5522	0.5603	0.5661	0.5721 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			18.0000	674.2800 (32e)					
Internal Ceiling 2			21.2800			18.0000	383.0400 (32e)					
Heat capacity Cm = Sum(A x K)							(28)...(30) + (32) + (32a)...(32e) = 31393.6275 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							263.0824 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 58.2981	Feb 57.9697	Mar 57.6477	Apr 56.1354	May 55.8525	Jun 54.5353	Jul 54.5353	Aug 54.2914	Sep 55.0427	Oct 55.8525	Nov 56.4248	Dec 57.0233 (38)
Heat transfer coeff	145.3706	145.0421	144.7202	143.2079	142.9250	141.6078	141.6078	141.3639	142.1151	142.9250	143.4973	144.0957 (39)
Average = Sum(39)m / 12 =												143.2065 (39)
HLP	Jan 1.2182	Feb 1.2155	Mar 1.2128	Apr 1.2001	May 1.1977	Jun 1.1867	Jul 1.1867	Aug 1.1846	Sep 1.1909	Oct 1.1977	Nov 1.2025	Dec 1.2075 (40)
HLP (average)												1.2001 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													2.8607 (42)
Average daily hot water use (litres/day)													102.1413 (43)
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555	(44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625	(45)
Energy content (annual)													Total = Sum(45)m = 1607.0811 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9930	21.8590	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0260 (55)
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(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	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(64)
Total per year (kWh/year) = Sum(64)m =													2255.4671 (64)
Heat gains from water heating, kWh/month	99.4558	88.2455	94.0551	86.2251	85.8818	78.7272	77.5008	82.4345	81.4718	89.3169	92.0408	97.7078	(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	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.3724	56.2868	45.7755	34.6550	25.9050	21.8701	23.6314	30.7170	41.2283	52.3488	61.0988	65.1337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.3856	428.7894	417.6920	394.0669	364.2445	336.2156	317.4906	313.0868	324.1842	347.8093	377.6317	405.6606	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	(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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	(71)
Water heating gains (Table 5)	133.6772	131.3178	126.4181	119.7571	115.4326	109.3434	104.1677	110.7991	113.1553	120.0496	127.8345	131.3276	(72)
Total internal gains	736.6738	731.6326	705.1242	663.7176	620.8207	582.6676	560.5283	569.8415	593.8064	635.4463	681.8036	717.3606	(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							
Southeast	12.1800	36.7938	0.6300	0.7000	0.7700	136.9601 (77)							
Southeast	5.0900	36.7938	0.6300	0.7000	0.7700	57.2354 (77)							
Northwest	11.2000	11.2829	0.6300	0.7000	0.7700	38.6200 (81)							
Northwest	2.0200	16.3666	0.6300	0.7000	1.0000	13.1217 (82)							
Horizontal	0.3600	26.0000	0.6300	0.7000	1.0000	3.7150 (82)							
Solar gains	249.6522	444.1209	657.7587	898.9072	1083.4051	1109.2342	1055.4116	912.6279	740.4630	504.3577	302.4631	211.4256	(83)
Total gains	986.3260	1175.7535	1362.8830	1562.6249	1704.2258	1691.9018	1615.9398	1482.4694	1334.2693	1139.8040	984.2667	928.7862	(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	59.9877	60.1236	60.2573	60.8937	61.0142	61.5817	61.5817	61.6880	61.3619	61.0142	60.7708	60.5185	
alpha	4.9992	5.0082	5.0172	5.0596	5.0676	5.1054	5.1054	5.1125	5.0908	5.0676	5.0514	5.0346	
util living area	0.9934	0.9838	0.9566	0.8749	0.7174	0.5252	0.3837	0.4350	0.6870	0.9241	0.9855	0.9950	(86)
MIT	20.1347	20.2854	20.5003	20.7409	20.8865	20.9368	20.9452	20.9438	20.9107	20.7030	20.3708	20.1062	(87)
Th 2	19.9054	19.9076	19.9098	19.9199	19.9218	19.9307	19.9307	19.9323	19.9273	19.9218	19.9180	19.9140	(88)
util rest of house	0.9912	0.9784	0.9426	0.8391	0.6532	0.4421	0.2915	0.3360	0.5987	0.8930	0.9798	0.9933	(89)
MIT 2	18.7668	18.9859	19.2919	19.6216	19.7924	19.8471	19.8523	19.8535	19.8250	19.5844	19.1195	18.7322	(90)
Living area fraction													fLA = Living area / (4) = 0.2338 (91)
MIT	19.0866	19.2897	19.5744	19.8833	20.0482	20.1019	20.1078	20.1084	20.0788	19.8459	19.4121	19.0535	(92)
Temperature adjustment													0.0000
adjusted MIT	19.0866	19.2897	19.5744	19.8833	20.0482	20.1019	20.1078	20.1084	20.0788	19.8459	19.4121	19.0535	(93)

8. Space heating requirement

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9889	0.9745	0.9374	0.8377	0.6612	0.4557	0.3069	0.3525	0.6120	0.8903	0.9762	0.9915	(94)
Useful gains	975.3598	1145.8102	1277.5359	1309.0038	1126.7768	771.0228	495.8971	522.5662	816.5395	1014.7811	960.8873	920.8748	(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	2149.5427	2087.1113	1892.1309	1572.8981	1193.1637	779.1146	496.7315	524.2360	849.6821	1321.4752	1766.7471	2140.3216	(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	873.5921	632.5543	457.2587	190.0039	49.3919	0.0000	0.0000	0.0000	0.0000	228.1805	580.2191	907.2684	(98)
Space heating												3918.4688	(98)
Space heating per m2										(98) / (4) =		32.8372	(99)

8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
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 %)													175.1000	(206)	
Efficiency of secondary/supplementary heating system, %													0.0000	(208)	
Space heating requirement													2237.8462	(211)	
Space heating requirement	873.5921	632.5543	457.2587	190.0039	49.3919	0.0000	0.0000	0.0000	0.0000	228.1805	580.2191	907.2684	(98)		
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)		
Space heating fuel (main heating system)	498.9104	361.2532	261.1415	108.5116	28.2078	0.0000	0.0000	0.0000	0.0000	130.3144	331.3644	518.1430	(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 requirement	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(64)		
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)		
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)		
Fuel for water heating, kWh/month	126.6067	111.6311	117.3304	105.3080	103.2920	92.4296	88.8966	97.3709	97.1437	109.1920	115.2970	123.6042	(219)		
Water heating fuel used												1288.1023	(219)		
Annual totals kWh/year															
Space heating fuel - main system													2237.8462	(211)	
Space heating fuel - secondary													0.0000	(215)	
Electricity for pumps and fans:															
central heating pump													30.0000	(230c)	
Total electricity for the above, kWh/year													30.0000	(231)	
Electricity for lighting (calculated in Appendix L)													447.6708	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)															
PV Unit 0 (0.80 * 1.20 * 951 * 1.00) =													-912.5914	-2246.4795	
PV Unit 1 (0.80 * 1.20 * 677 * 1.00) =													-649.4447	-2246.4795	
PV Unit 2 (0.80 * 0.90 * 951 * 1.00) =													-684.4435	-2246.4795	
Total delivered energy for all uses														1757.1398	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2237.8462	13.1900	295.1719	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1288.1023	13.1900	169.9007	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	447.6708	13.1900	59.0478	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit		-2246.4795	13.1900	-296.3107
Total energy cost			231.7667	(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] =	0.5924	(257)
SAP value		91.7366	
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	2237.8462	0.5190	1161.4422	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1288.1023	0.5190	668.5251	(264)

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Space and water heating			1829.9673 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	447.6708	0.5190	232.3411 (268)
Energy saving/generation technologies			
PV Unit	-2246.4795	0.5190	-1165.9229 (269)
Total kg/year			911.9555 (272)
CO2 emissions per m2			7.6400 (273)
EI value			92.5636
EI rating			93 (274)
EI band			A

 Calculation of stars for heating and DHW

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.25) / 1.7510 = 8.079$, stars = 2
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.25) / 1.7510 = 0.3179$, stars = 4
Water heating energy efficiency	$13.19 / 1.7510 = 7.533$, stars = 2
Water heating environmental impact	$0.519 / 1.7510 = 0.2964$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					3 * 10 = 30.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 30.0000 / (5) = 0.0993 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3493 (18)							
Number of sides sheltered					1 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3231 (21)							
Wind speed	Jan 4.2000	Feb 3.9000	Mar 4.0000	Apr 3.7000	May 3.8000	Jun 3.2000	Jul 3.3000	Aug 3.6000	Sep 3.4000	Oct 3.6000	Nov 3.5000	Dec 3.9000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9250	0.9500	0.8000	0.8250	0.9000	0.8500	0.9000	0.8750	0.9750 (22a)
Adj infilt rate	0.3393	0.3150	0.3231	0.2989	0.3070	0.2585	0.2666	0.2908	0.2747	0.2908	0.2827	0.3150 (22b)
Effective ac	0.5576	0.5496	0.5522	0.5447	0.5471	0.5334	0.5355	0.5423	0.5377	0.5423	0.5400	0.5496 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			18.0000	674.2800 (32e)					
Internal Ceiling 2			21.2800			18.0000	383.0400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 31393.6275 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							263.0824 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 55.5760	Feb 54.7857	Mar 55.0427	Apr 54.2914	May 54.5353	Jun 53.1694	Jul 53.3808	Aug 54.0540	Sep 53.5987	Oct 54.0540	Nov 53.8231	Dec 54.7857 (38)
Heat transfer coeff	142.6485	141.8582	142.1151	141.3639	141.6078	140.2419	140.4533	141.1265	140.6712	141.1265	140.8956	141.8582 (39)
Average = Sum(39)m / 12 =												141.3306 (39)
HLP	Jan 1.1954	Feb 1.1888	Mar 1.1909	Apr 1.1846	May 1.1867	Jun 1.1752	Jul 1.1770	Aug 1.1827	Sep 1.1788	Oct 1.1827	Nov 1.1807	Dec 1.1888 (40)
HLP (average)												1.1844 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													2.8607 (42)
Average daily hot water use (litres/day)													102.1413 (43)
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555	(44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625	(45)
Distribution loss (46)m = 0.15 x (45)m	24.9930	21.8590	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0260 (55)
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(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)
Output from w/h	221.6883	195.4661	205.4455	184.3944	180.8642	161.8442	155.6580	170.4965	170.0986	191.1953	201.8851	216.4309	(64)
Heat gains from water heating, kWh/month	99.4558	88.2455	94.0551	86.2251	85.8818	78.7272	77.5008	82.4345	81.4718	89.3169	92.0408	97.7078	(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	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.3724	56.2868	45.7755	34.6550	25.9050	21.8701	23.6314	30.7170	41.2283	52.3488	61.0988	65.1337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.3856	428.7894	417.6920	394.0669	364.2445	336.2156	317.4906	313.0868	324.1842	347.8093	377.6317	405.6606	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	(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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	(71)
Water heating gains (Table 5)	133.6772	131.3178	126.4181	119.7571	115.4326	109.3434	104.1677	110.7991	113.1553	120.0496	127.8345	131.3276	(72)
Total internal gains	736.6738	731.6326	705.1242	663.7176	620.8207	582.6676	560.5283	569.8415	593.8064	635.4463	681.8036	717.3606	(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							
Southeast	12.1800	40.4699	0.6300	0.7000	0.7700	150.6438 (77)							
Southeast	5.0900	40.4699	0.6300	0.7000	0.7700	62.9538 (77)							
Northwest	11.2000	12.9236	0.6300	0.7000	0.7700	44.2356 (81)							
Northwest	2.0200	18.7850	0.6300	0.7000	1.0000	15.0607 (82)							
Horizontal	0.3600	30.0000	0.6300	0.7000	1.0000	4.2865 (82)							
Solar gains	277.1804	428.9502	647.3041	914.3800	1074.3119	1191.1753	1136.9650	999.0369	806.1546	540.2767	344.2556	232.3419	(83)
Total gains	1013.8543	1160.5828	1352.4283	1578.0976	1695.1325	1773.8429	1697.4933	1568.8784	1399.9610	1175.7230	1026.0591	949.7025	(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, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	61.1324	61.4730	61.3619	61.6880	61.5817	62.1815	62.0879	61.7918	61.9918	61.7918	61.8930	61.4730	
alpha	5.0755	5.0982	5.0908	5.1125	5.1054	5.1454	5.1392	5.1195	5.1328	5.1195	5.1262	5.0982	
util living area	0.9896	0.9788	0.9356	0.8098	0.6037	0.3469	0.1985	0.2338	0.5134	0.8586	0.9737	0.9921	(86)
MIT	20.2673	20.3883	20.6191	20.8306	20.9250	20.9462	20.9471	20.9469	20.9399	20.8160	20.5094	20.2393	(87)
Th 2	19.9237	19.9290	19.9273	19.9323	19.9307	19.9399	19.9384	19.9339	19.9370	19.9339	19.9355	19.9290	(88)
util rest of house	0.9858	0.9715	0.9143	0.7588	0.5265	0.2638	0.1107	0.1380	0.4130	0.8040	0.9629	0.9892	(89)
MIT 2	18.9739	19.1514	19.4712	19.7424	19.8379	19.8623	19.8611	19.8562	19.8564	19.7355	19.3316	18.9378	(90)
Living area fraction													fLA = Living area / (4) = 0.2338 (91)
MIT	19.2763	19.4406	19.7396	19.9968	20.0921	20.1157	20.1150	20.1112	20.1097	19.9882	19.6070	19.2421	(92)
Temperature adjustment													0.0000
adjusted MIT	19.2763	19.4406	19.7396	19.9968	20.0921	20.1157	20.1150	20.1112	20.1097	19.9882	19.6070	19.2421	(93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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	1703.4360	3.0700	5229.5487 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1288.1023	3.0700	3954.4740 (264)
Space and water heating			9184.0227 (265)
Pumps and fans	30.0000	3.0700	92.1000 (267)
Energy for lighting	447.6708	3.0700	1374.3493 (268)
Energy saving/generation technologies			
PV Unit	-2406.7110	3.0700	-7388.6027 (269)
Primary energy kWh/year			3261.8692 (272)
Primary energy kWh/m2/year			27.3349 (273)

SAP 2012 EPC IMPROVEMENTS

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

(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	+ 2.3	-£ 155	-258 kg (46.8%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£155	2.16 kg/m ²	A 94 A 95
Total Savings	£155	2.16 kg/m²	

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

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£1078	£924	£155
Space heating	£539	£539	-£1
Water heating	£400	£245	£155
Lighting	£139	£139	£0
Generated (PV)	-£748	-£748	£0
Total cost of fuels	£330	£176	£155
Total cost of uses	£330	£175	£154
Delivered energy	9 kWh/m ²	5 kWh/m ²	4 kWh/m ²
Carbon dioxide emissions	0.6 tonnes	0.3 tonnes	0.3 tonnes
CO2 emissions per m ²	5 kg/m ²	2 kg/m ²	2 kg/m ²
Primary energy	27 kWh/m ²	15 kWh/m ²	13 kWh/m ²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					3 * 10 = 30.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 30.0000 / (5) = 0.0993 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3493 (18)							
Number of sides sheltered					1 (19)							
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.9250 (20)							
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.3231 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.4120	0.4039	0.3958	0.3554	0.3474	0.3070	0.3070	0.2989	0.3231	0.3474	0.3635	0.3797 (22b)
Effective ac	0.5849	0.5816	0.5783	0.5632	0.5603	0.5471	0.5471	0.5447	0.5522	0.5603	0.5661	0.5721 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			18.0000	674.2800 (32e)					
Internal Ceiling 2			21.2800			18.0000	383.0400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 31393.6275 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							263.0824 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 58.2981	Feb 57.9697	Mar 57.6477	Apr 56.1354	May 55.8525	Jun 54.5353	Jul 54.5353	Aug 54.2914	Sep 55.0427	Oct 55.8525	Nov 56.4248	Dec 57.0233 (38)
Heat transfer coeff	145.3706	145.0421	144.7202	143.2079	142.9250	141.6078	141.6078	141.3639	142.1151	142.9250	143.4973	144.0957 (39)
Average = Sum(39)m / 12 =												143.2065 (39)
HLP	Jan 1.2182	Feb 1.2155	Mar 1.2128	Apr 1.2001	May 1.1977	Jun 1.1867	Jul 1.1867	Aug 1.1846	Sep 1.1909	Oct 1.1977	Nov 1.2025	Dec 1.2075 (40)
HLP (average)												1.2001 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8607 (42)
Average daily hot water use (litres/day)												102.1413 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555 (44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625 (45)
Energy content (annual)												Total = Sum(45)m = 1607.0811 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9930	21.8560	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0260 (55)
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (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	221.6883	195.4661	204.0497	177.6408	168.0699	149.2375	142.6311	158.4000	164.6958	189.7995	201.8851	216.4309 (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												1.1285 (H8)
Utilisation factor												0.5878 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												102.1413 (H14)
Volume ratio Veff/V												0.7343 (H15)
Solar storage volume factor												0.9382 (H16)
Solar input												-879.3795 (H17)
Solar input	-25.5003	-42.5526	-72.4719	-97.1267	-119.9918	-117.9711	-116.4120	-101.7098	-79.6592	-54.3978	-30.2470	-21.3394 (63)
Solar input (sum of months) = Sum(63)m =												-879.3795 (63)
Output from w/h	196.1881	152.9135	131.5778	80.5141	48.0781	31.2665	26.2190	56.6902	85.0366	135.4017	171.6381	195.0915 (64)
Total per year (kWh/year) = Sum(64)m =												1310.6152 (64)
Heat gains from water heating, kWh/month	99.4558	86.2455	92.9385	80.8223	75.6464	68.6418	67.0792	72.7574	77.1495	88.2003	92.0408	97.7078 (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	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.3724	56.2868	45.7755	34.6550	25.9050	21.8701	23.6314	30.7170	41.2283	52.3488	61.0988	65.1337 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.3856	428.7894	417.6920	394.0669	364.2445	336.2156	317.4906	313.0868	324.1842	347.8093	377.6317	405.6606 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248 (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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275 (71)
Water heating gains (Table 5)	133.6772	131.3178	124.9173	112.2531	101.6752	95.3359	90.1602	97.7922	107.1521	118.5488	127.8345	131.3276 (72)
Total internal gains	736.6738	731.6326	703.6234	656.2136	607.0633	568.6602	546.5208	556.8346	587.8032	633.9455	681.8036	717.3606 (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						
Southeast	12.1800	36.7938	0.6300	0.7000	0.7700	136.9601 (77)						
Southeast	5.0900	36.7938	0.6300	0.7000	0.7700	57.2354 (77)						
Northwest	11.2000	11.2829	0.6300	0.7000	0.7700	38.6200 (81)						
Northwest	2.0200	16.3666	0.6300	0.7000	1.0000	13.1217 (82)						
Horizontal	0.3600	26.0000	0.6300	0.7000	1.0000	3.7150 (82)						
Solar gains	249.6522	444.1209	657.7587	898.9072	1083.4051	1109.2342	1055.4116	912.6279	740.4630	504.3577	302.4631	211.4256 (83)
Total gains	986.3260	1175.7535	1361.3822	1555.1209	1690.4685	1677.8944	1601.9324	1469.4624	1328.2661	1138.3032	984.2667	928.7862 (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	59.9877	60.1236	60.2573	60.8937	61.0142	61.5817	61.5817	61.6880	61.3619	61.0142	60.7708	60.5185
alpha	4.9992	5.0082	5.0172	5.0596	5.0676	5.1054	5.1054	5.1125	5.0908	5.0676	5.0514	5.0346

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

util living area	0.9934	0.9838	0.9567	0.8766	0.7215	0.5292	0.3870	0.4387	0.6893	0.9245	0.9855	0.9950 (86)
MIT	20.1347	20.2854	20.4996	20.7387	20.8849	20.9365	20.9451	20.9437	20.9101	20.7024	20.3708	20.1062 (87)
Th 2	19.9054	19.9076	19.9098	19.9199	19.9218	19.9307	19.9307	19.9323	19.9273	19.9218	19.9180	19.9140 (88)
util rest of house												
MIT 2	0.9912	0.9784	0.9428	0.8410	0.6574	0.4457	0.2940	0.3389	0.6010	0.8934	0.9798	0.9933 (89)
Living area fraction	18.7668	18.9859	19.2910	19.6190	19.7909	19.8469	19.8523	19.8534	19.8246	19.5837	19.1195	18.7322 (90)
MIT	19.0866	19.2897	19.5736	19.8808	20.0467	20.1017	20.1078	20.1084	fLA = Living area / (4) =			0.2338 (91)
Temperature adjustment									20.0784	19.8453	19.4121	19.0535 (92)
adjusted MIT	19.0866	19.2897	19.5736	19.8808	20.0467	20.1017	20.1078	20.1084	20.0784	19.8453	19.4121	0.0000
												19.0535 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9889	0.9745	0.9376	0.8396	0.6653	0.4593	0.3095	0.3556	0.6143	0.8907	0.9762	0.9915 (94)
Useful gains	975.3598	1145.8102	1276.4300	1305.6565	1124.6997	770.6962	495.8581	522.4890	815.9224	1013.9057	960.8873	920.8748 (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	2149.5427	2087.1113	1892.0065	1572.5332	1192.9475	779.0807	496.7270	524.2273	849.6181	1321.3786	1766.7471	2140.3216 (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	873.5921	632.5543	457.9889	192.1512	50.7764	0.0000	0.0000	0.0000	0.0000	228.7599	580.2191	907.2684 (98)
Space heating												3923.3102 (98)
Space heating per m2										(98) / (4) =		32.8778 (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 %)												175.1000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2240.6112 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	873.5921	632.5543	457.9889	192.1512	50.7764	0.0000	0.0000	0.0000	0.0000	228.7599	580.2191	907.2684 (98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000 (210)
Space heating fuel (main heating system)	498.9104	361.2532	261.5585	109.7380	28.9985	0.0000	0.0000	0.0000	0.0000	130.6453	331.3644	518.1430 (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 requirement	196.1881	152.9135	131.5778	80.5141	48.0781	31.2665	26.2190	56.6902	85.0366	135.4017	171.6381	195.0915 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	112.0434	87.3292	75.1444	45.9818	27.4575	17.8563	14.9737	32.3759	48.5646	77.3282	98.0229	111.4172 (219)
Water heating fuel used												748.4953 (219)
Annual totals kWh/year												2240.6112 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
Electricity for pumps and fans:												30.0000 (230c)
central heating pump												50.0000 (230g)
pump for solar water heating												80.0000 (231)
Total electricity for the above, kWh/year												447.6708 (232)
Electricity for lighting (calculated in Appendix L)												
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.20 * 951 * 1.00) =										-912.5914		-2246.4795
PV Unit 1 (0.80 * 1.20 * 677 * 1.00) =										-649.4447		-2246.4795
PV Unit 2 (0.80 * 0.90 * 951 * 1.00) =										-684.4435		-2246.4795 (233)
Total delivered energy for all uses												1270.2977 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2240.6112	13.1900	295.5366 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	748.4953	13.1900	98.7265 (247)
Pumps and fans for heating	30.0000	13.1900	3.9570 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	447.6708	13.1900	59.0478 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-2246.4795	13.1900	-296.3107 (252)
Total energy cost			167.5523 (255)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4282 (257)
SAP value		94.0261
SAP rating (Section 12)		94 (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	2240.6112	0.5190	1162.8772 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	748.4953	0.5190	388.4690 (264)
Space and water heating			1551.3463 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	447.6708	0.5190	232.3411 (268)
Energy saving/generation technologies			
PV Unit	-2246.4795	0.5190	-1165.9229 (269)
Total kg/year			659.2845 (272)
CO2 emissions per m2			5.5200 (273)
EI value			94.6240
EI rating			95 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	60.5900 (1b)	x 2.5000 (2b)	= 151.4750 (1b) - (3b)
First floor	37.4600 (1c)	x 2.7700 (2c)	= 103.7642 (1c) - (3c)
Second floor	21.2800 (1d)	x 2.2000 (2c)	= 46.8160 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.3300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 302.0552 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 30.0000 / (5) = 0.0993 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3493 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3231 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.7000	3.8000	3.2000	3.3000	3.6000	3.4000	3.6000	3.5000	3.9000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9250	0.9500	0.8000	0.8250	0.9000	0.8500	0.9000	0.8750	0.9750 (22a)
Adj infilt rate	0.3393	0.3150	0.3231	0.2989	0.3070	0.2585	0.2666	0.2908	0.2747	0.2908	0.2827	0.3150 (22b)
Effective ac	0.5576	0.5496	0.5522	0.5447	0.5471	0.5334	0.5355	0.5423	0.5377	0.5423	0.5400	0.5496 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Entrance door			1.9700	1.0000	1.9700		(26)					
Glazed door (Uw = 1.20)			12.1800	1.1450	13.9466		(27)					
Window (Uw = 1.20)			16.2900	1.1450	18.6527		(27)					
Roof lights (Uw = 1.30)			2.3800	1.2357	2.9411		(27a)					
Heat Loss Floor 1			60.5900	0.1200	7.2708	110.0000	6664.9000 (28a)					
Cavity wall	110.9800	26.0300	84.9500	0.1700	14.4415	60.0000	5097.0000 (29a)					
Stud to eaves	7.7500		7.7500	0.1800	1.3950	12.1700	94.3175 (29a)					
Dormer walls	27.3200	4.4100	22.9100	0.1800	4.1238	9.0000	206.1900 (29a)					
Eaves void	16.1800		16.1800	0.1100	1.7798	9.0000	145.6200 (30)					
Ground floor flat roof	23.1300		23.1300	0.1300	3.0069	9.0000	208.1700 (30)					
Dormer flat roof	15.4100	0.3600	15.0500	0.1300	1.9565	9.0000	135.4500 (30)					
Sloping ceiling	7.3300	2.0200	5.3100	0.1300	0.6903	9.0000	47.7900 (30)					
Total net area of external elements Aum(A, m ²)			268.6900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1749		(33)					
Party Wall 1			50.0800	0.0000	0.0000	180.0000	9014.4000 (32)					
Internal Wall 1			83.3500			9.0000	750.1500 (32c)					
Internal Wall 2			92.2000			75.0000	6915.0000 (32c)					
Internal Floor 1			37.4600			18.0000	674.2800 (32d)					
Internal Floor 2			21.2800			18.0000	383.0400 (32d)					
Internal Ceiling 1			37.4600			18.0000	674.2800 (32e)					
Internal Ceiling 2			21.2800			18.0000	383.0400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 31393.6275 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							263.0824 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8976 (36)					
Total fabric heat loss							(33) + (36) = 87.0725 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 55.5760	Feb 54.7857	Mar 55.0427	Apr 54.2914	May 54.5353	Jun 53.1694	Jul 53.3808	Aug 54.0540	Sep 53.5987	Oct 54.0540	Nov 53.8231	Dec 54.7857 (38)
Heat transfer coeff	142.6485	141.8582	142.1151	141.3639	141.6078	140.2419	140.4533	141.1265	140.6712	141.1265	140.8956	141.8582 (39)
Average = Sum(39)m / 12 =												141.3306 (39)
HLP	Jan 1.1954	Feb 1.1888	Mar 1.1909	Apr 1.1846	May 1.1867	Jun 1.1752	Jul 1.1770	Aug 1.1827	Sep 1.1788	Oct 1.1827	Nov 1.1807	Dec 1.1888 (40)
HLP (average)												1.1844 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8607 (42)
Average daily hot water use (litres/day)												102.1413 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.3555	108.2698	104.1842	100.0985	96.0129	91.9272	91.9272	96.0129	100.0985	104.1842	108.2698	112.3555 (44)
Energy content (annual)	166.6199	145.7269	150.3771	131.1024	125.7958	108.5522	100.5896	115.4281	116.8066	136.1269	148.5931	161.3625 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9930	21.8560	22.5566	19.6654	18.8694	16.2828	15.0884	17.3142	17.5210	20.4190	22.2890	24.2044 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0260 (55)
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (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	221.6883	195.4661	204.0497	177.6408	168.0699	149.2375	142.6311	158.4000	164.6958	189.7995	201.8851	216.4309 (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												1135.8676 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1908.2575 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1874 (H8)
Utilisation factor												0.5692 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												102.1413 (H14)
Volume ratio Veff/V												0.7343 (H15)
Solar storage volume factor												0.9382 (H16)
Solar input												-896.1138 (H17)
Solar input	-27.6847	-40.1240	-69.3615	-95.6333	-114.8660	-122.2146	-121.0129	-107.6295	-84.1801	-56.8187	-33.6515	-22.9370 (63)
Solar input (sum of months) = Sum(63)m =												-896.1138 (63)
Output from w/h	194.0036	155.3421	134.6882	82.0074	53.2039	27.0229	21.6182	50.7705	80.5157	132.9808	168.2336	193.4940 (64)
Total per year (kWh/year) = Sum(64)m =												1293.8809 (64)
Heat gains from water heating, kWh/month	99.4558	86.2455	92.9385	80.8223	75.6464	68.6418	67.0792	72.7574	77.1495	88.2003	92.0408	97.7078 (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	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413	171.6413 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.3724	56.2868	45.7755	34.6550	25.9050	21.8701	23.6314	30.7170	41.2283	52.3488	61.0988	65.1337 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.3856	428.7894	417.6920	394.0669	364.2445	336.2156	317.4906	313.0868	324.1842	347.8093	377.6317	405.6606 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248	55.0248 (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)	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275	-114.4275 (71)
Water heating gains (Table 5)	133.6772	131.3178	124.9173	112.2531	101.6752	95.3359	90.1602	97.7922	107.1521	118.5488	127.8345	131.3276 (72)
Total internal gains	736.6738	731.6326	703.6234	656.2136	607.0633	568.6602	546.5208	556.8346	587.8032	633.9455	681.8036	717.3606 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Southeast	12.1800	40.4699	0.6300	0.7000	0.7700	150.6438 (77)						
Southeast	5.0900	40.4699	0.6300	0.7000	0.7700	62.9538 (77)						
Northwest	11.2000	12.9236	0.6300	0.7000	0.7700	44.2356 (81)						
Northwest	2.0200	18.7850	0.6300	0.7000	1.0000	15.0607 (82)						
Horizontal	0.3600	30.0000	0.6300	0.7000	1.0000	4.2865 (82)						
Solar gains	277.1804	428.9502	647.3041	914.3800	1074.3119	1191.1753	1136.9650	999.0369	806.1546	540.2767	344.2556	232.3419 (83)
Total gains	1013.8543	1160.5828	1350.9275	1570.5936	1681.3752	1759.8355	1683.4858	1555.8714	1393.9578	1174.2222	1026.0591	949.7025 (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	61.1324	61.4730	61.3619	61.6880	61.5817	62.1815	62.0879	61.7918	61.9918	61.7918	61.8930	61.4730
alpha	5.0755	5.0982	5.0908	5.1125	5.1054	5.1454	5.1392	5.1195	5.1328	5.1195	5.1262	5.0982

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util living area	0.9896	0.9788	0.9359	0.8119	0.6079	0.3496	0.2002	0.2357	0.5155	0.8591	0.9737	0.9921 (86)
MIT	20.2673	20.3883	20.6184	20.8291	20.9244	20.9462	20.9471	20.9469	20.9398	20.8156	20.5094	20.2393 (87)
Th 2	19.9237	19.9290	19.9273	19.9323	19.9307	19.9399	19.9384	19.9339	19.9370	19.9339	19.9355	19.9290 (88)
util rest of house												
MIT 2	0.9858	0.9715	0.9146	0.7612	0.5305	0.2659	0.1117	0.1391	0.4147	0.8046	0.9629	0.9892 (89)
Living area fraction	18.9739	19.1514	19.4704	19.7408	19.8374	19.8623	19.8611	19.8562	19.8563	19.7351	19.3316	18.9378 (90)
MIT	19.2763	19.4406	19.7388	19.9952	20.0915	20.1157	20.1150	20.1112	fLA = Living area / (4) =			0.2338 (91)
Temperature adjustment									20.1096	19.9877	19.6070	19.2421 (92)
adjusted MIT	19.2763	19.4406	19.7388	19.9952	20.0915	20.1157	20.1150	20.1112	20.1096	19.9877	19.6070	0.0000
												19.2421 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9829	0.9673	0.9102	0.7645	0.5426	0.2799	0.1264	0.1552	0.4315	0.8077	0.9586	0.9867 (94)
Useful gains	996.4787	1122.5991	1229.5787	1200.6612	912.2522	492.5386	212.7808	241.4848	601.4415	948.4353	983.6067	937.0920 (95)
Ext temp.	5.5000	6.0000	8.0000	10.5000	13.5000	16.6000	18.6000	18.4000	15.8000	12.2000	8.4000	5.5000 (96)
Heat loss rate W												
1965.1703	1906.6581	1668.2667	1342.2802	933.4111	493.0479	212.7853	241.4996	606.2430	1099.0548	1579.0170	1949.4314 (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												
720.7066	526.8876	326.3839	101.9657	15.7423	0.0000	0.0000	0.0000	0.0000	112.0609	428.6954	753.1805 (98)	
Space heating												2985.6229 (98)
Space heating per m2										(98) / (4) =		25.0199 (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 %)												175.1000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												1705.0959 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	720.7066	526.8876	326.3839	101.9657	15.7423	0.0000	0.0000	0.0000	0.0000	112.0609	428.6954	753.1805 (98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000 (210)
Space heating fuel (main heating system)	411.5971	300.9067	186.3986	58.2328	8.9904	0.0000	0.0000	0.0000	0.0000	63.9982	244.8289	430.1431 (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 requirement												
194.0036	155.3421	134.6882	82.0074	53.2039	27.0229	21.6182	50.7705	80.5157	132.9808	168.2336	193.4940 (64)	
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	110.7959	88.7162	76.9207	46.8346	30.3849	15.4328	12.3462	28.9952	45.9827	75.9456	96.0786	110.5048 (219)
Water heating fuel used												738.9383 (219)
Annual totals kWh/year												
Space heating fuel - main system												1705.0959 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												80.0000 (231)
Electricity for lighting (calculated in Appendix L)												447.6708 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.20 * 1015 * 1.00) =										-974.5229		-2406.7110
PV Unit 1 (0.80 * 1.20 * 731 * 1.00) =										-701.2959		-2406.7110
PV Unit 2 (0.80 * 0.90 * 1015 * 1.00) =										-730.8922		-2406.7110 (233)
Total delivered energy for all uses												564.9940 (238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1705.0959	31.0800	529.9438 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	738.9383	31.0800	229.6620 (247)
Pumps and fans for heating	30.0000	31.0800	9.3240 (249)
Pump for solar water heating	50.0000	31.0800	15.5400 (249)
Energy for lighting	447.6708	31.0800	139.1361 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-2406.7110	31.0800	-748.0058 (252)
Total energy cost			175.6001 (255)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

 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	1705.0959	0.5190	884.9448 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	738.9383	0.5190	383.5090 (264)
Space and water heating			1268.4537 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	447.6708	0.5190	232.3411 (268)
Energy saving/generation technologies			
PV Unit	-2406.7110	0.5190	-1249.0830 (269)
Total kg/year			293.2319 (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	1705.0959	3.0700	5234.6444 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	738.9383	3.0700	2268.5405 (264)
Space and water heating			7503.1849 (265)
Pumps and fans	80.0000	3.0700	245.6000 (267)
Energy for lighting	447.6708	3.0700	1374.3493 (268)
Energy saving/generation technologies			
PV Unit	-2406.7110	3.0700	-7388.6027 (269)
Primary energy kWh/year			1734.5314 (272)
Primary energy kWh/m2/year			14.5356 (273)