

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

<b>Property Reference</b>	Ham Farm Road 25		<b>Issued on Date</b>	11/02/2022	
<b>Assessment Reference</b>	25 Actual	<b>Prop Type Ref</b>			
<b>Property</b>	25, Ham Farm Road, London, TW10 5NA				
<b>SAP Rating</b>	92 A	<b>DER</b>	7.71	<b>TER</b>	34.38
<b>Environmental</b>	93 A	<b>% DER&lt;TER</b>	77.57		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.76	<b>DFEE</b>	86.86	<b>TFEE</b>	94.46
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	8.05		
<b>Assessor Details</b>	Mr. Damian Selim, Damian Selim, Tel: 07747633234, damianselim@yahoo.co.uk			<b>Assessor ID</b>	L673-0001
<b>Client</b>					

# 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

Detached Bungalow, total floor area 166 m<sup>2</sup>

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) 34.38 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 7.71 kgCO<sub>2</sub>/m<sup>2</sup>OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)94.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)86.9 kWh/m<sup>2</sup>/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.22 (max. 2.00)	1.40 (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: 4.00 (design value)  
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Heat pump with radiators or underfloor - Electric  
Daikin Altherma ERGA06DAV3A + EHBX08DA6V

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.61 kWh/day  
Permitted by DBSCG 2.56 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): Medium OK

Based on:

Overshading: Average  
Windows facing North East: 33.84 m<sup>2</sup>, No overhang  
Windows facing South East: 18.50 m<sup>2</sup>, No overhang  
Windows facing South West: 35.11 m<sup>2</sup>, No overhang  
Windows facing North West: 32.13 m<sup>2</sup>, No overhang  
Air change rate: 6.00 ach  
Blinds/curtains: None

10 Key features

Roof U-value	0.11 W/m <sup>2</sup> K
Floor U-value	0.11 W/m <sup>2</sup> K
Door U-value	0.60 W/m <sup>2</sup> K
Window U-value	0.80 W/m <sup>2</sup> K
Roof window U-value	0.80 W/m <sup>2</sup> K
Photovoltaic array	3.70 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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				5 * 10 =	50.0000 (7a)
Number of passive vents				5 * 10 =	50.0000 (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) =				100.0000 / (5) =	0.2116 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate					0.4116 (18)
Number of sides sheltered				2	(19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3498 (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 infiltr rate												
Effective ac	0.4461	0.4373	0.4286	0.3848	0.3761	0.3324	0.3324	0.3236	0.3498	0.3761	0.3936	0.4111 (22b)
Effective ac	0.5995	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5524	0.5612	0.5707	0.5775	0.5845 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	202.8398	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							83.9220 (36)
Total fabric heat loss						(33) + (36) =	286.7618 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	93.5003	92.8978	92.3072	89.5333	89.0143	86.5984	86.5984	86.1510	87.5290	89.0143	90.0642	91.1619 (38)
Heat transfer coeff	380.2621	379.6596	379.0690	376.2951	375.7761	373.3602	373.3602	372.9127	374.2907	375.7761	376.8260	377.9236 (39)
Average = Sum(39)m / 12 =												376.2926 (39)
HLP	2.2850	2.2813	2.2778	2.2611	2.2580	2.2435	2.2435	2.2408	2.2491	2.2580	2.2643	2.2709 (40)
HLP (average)												2.2611 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Store volume												250.0000 (47)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)			
Temperature factor from Table 2b												0.5400 (49)			
Enter (49) or (54) in (55)												0.8694 (55)			
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	26.0820	26.9514	(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	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181	215.2181	215.2181	(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	0.0000	0.0000	(63)
Output from w/h	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181	215.2181	215.2181	(64)
Heat gains from water heating, kWh/month	96.8225	85.8313	91.2999	83.4506	82.9422	75.7834	74.3719	79.4171	78.5900	86.4548	89.3975	95.0350	95.0350	95.0350	(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	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.1223	26.7544	21.7581	16.4723	12.3132	10.3953	11.2325	14.6005	19.5967	24.8825	29.0416	30.9595	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.8805	341.3866	332.5513	313.7418	289.9983	267.6827	252.7745	249.2683	258.1037	276.9132	300.6567	322.9723	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	(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)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	(71)
Water heating gains (Table 5)	130.1378	127.7251	122.7149	115.9036	111.4814	105.2548	99.9623	106.7434	109.1527	116.2026	124.1632	127.7352	(72)
Total internal gains	565.5068	563.2324	544.3905	513.4839	481.1592	450.6991	431.3356	437.9785	454.2194	485.3646	521.2278	549.0332	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
Northeast	26.0100	11.2829	0.5700	0.7000	0.7700	81.1463 (75)							
Southwest	2.9700	36.7938	0.5700	0.7000	0.7700	30.2160 (79)							
Northeast	7.8300	11.2829	0.6300	0.7000	0.7700	26.9995 (75)							
Southeast	18.5000	36.7938	0.6300	0.7000	0.7700	208.0265 (77)							
Southwest	32.1400	36.7938	0.6300	0.7000	0.7700	361.4038 (79)							
Northwest	32.1300	11.2829	0.6300	0.7000	0.7700	110.7911 (81)							
Horizontal	5.2800	26.0000	0.5700	0.7000	1.0000	49.2972 (82)							
Solar gains	867.8805	1569.4586	2382.4953	3334.6721	4076.1145	4194.4295	3982.5361	3408.2507	2709.6728	1798.6480	1056.2870	731.7842	(83)
Total gains	1433.3873	2132.6909	2926.8858	3848.1561	4557.2737	4645.1286	4413.8717	3846.2291	3163.8923	2284.0126	1577.5148	1280.8175	(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	30.3921	30.4403	30.4877	30.7124	30.7549	30.9539	30.9539	30.9910	30.8769	30.7549	30.6692	30.5801	
alpha	3.0261	3.0294	3.0325	3.0475	3.0503	3.0636	3.0636	3.0661	3.0585	3.0503	3.0446	3.0387	
util living area	0.9914	0.9728	0.9249	0.8122	0.6461	0.4795	0.3607	0.4244	0.6727	0.9089	0.9818	0.9938	(86)
Tweekday	16.8466	17.2967	17.9110	18.5408	18.8903	19.0208	19.0436	19.0420	18.9495	18.3953	17.4825	16.7725	
Tweekend	19.8248	20.0265	20.3095	20.6180	20.8177	20.9062	20.9316	20.9243	20.8395	20.5259	20.1038	19.7893	
24 / 16	7	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	18	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	4	19	0	0	0	0	0	0	0	0	0	22	
MIT	20.7725	19.9999	19.9343	20.4036	20.7186	20.8559	20.8944	20.8832	20.7494	20.2682	19.6006	19.7893	(87)
Th 2	19.1501	19.1524	19.1546	19.1649	19.1669	19.1760	19.1760	19.1776	19.1725	19.1669	19.1630	19.1588	(88)
util rest of house	0.9882	0.9630	0.8991	0.7543	0.5530	0.3568	0.2163	0.2658	0.5425	0.8642	0.9736	0.9915	(89)
Tweekday	16.8466	17.2967	17.9110	18.5408	18.8903	19.0208	19.0436	19.0420	18.9495	18.3953	17.4825	16.7725	
Tweekend	16.8466	17.2967	17.9110	18.5408	18.8903	19.0208	19.0436	19.0420	18.9495	18.3953	17.4825	16.7725	
MIT 2	18.7043	17.2967	17.9110	18.5408	18.8903	19.0208	19.0436	19.0420	18.9495	18.3953	17.4825	16.7725	(90)
Living area fraction												fLA = Living area / (4) = 0.4807 (91)	
MIT	19.6985	18.5962	18.8836	19.4362	19.7692	19.9029	19.9333	19.9271	19.8147	19.2956	18.5007	18.2227	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6985	18.5962	18.8836	19.4362	19.7692	19.9029	19.9333	19.9271	19.8147	19.2956	18.5007	18.2227	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9893	0.9592	0.8944	0.7641	0.5858	0.4077	0.2777	0.3335	0.5929	0.8681	0.9695	0.9898	(94)
Ext temp.	1418.0283	2045.7433	2617.8583	2940.1935	2669.8070	1893.8889	1225.9427	1282.6331	1876.0277	1982.7890	1529.4139	1267.7966	(95)
Heat loss rate W	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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	5855.4756	5199.8791	4694.2488	3964.7366	3032.2091	1979.9010	1244.5333	1315.2927	2138.9729	3267.6086	4296.0714	5299.5254 (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	3301.4608	2119.5792	1544.8345	737.6710	269.6272	0.0000	0.0000	0.0000	0.0000	955.9058	1991.9934	2999.6063 (98)
Space heating per m2												13920.6782 (98)
												(98) / (4) = 83.6479 (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 %)												390.3179 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												3566.4977 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	3301.4608	2119.5792	1544.8345	737.6710	269.6272	0.0000	0.0000	0.0000	0.0000	955.9058	1991.9934	2999.6063 (98)
Space heating efficiency (main heating system 1)	390.3179	390.3179	390.3179	390.3179	390.3179	0.0000	0.0000	0.0000	0.0000	390.3179	390.3179	390.3179 (210)
Space heating fuel (main heating system)	845.8390	543.0392	395.7888	188.9924	69.0789	0.0000	0.0000	0.0000	0.0000	244.9044	510.3516	768.5034 (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	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181 (64)
Efficiency of water heater	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600 (216)
Fuel for water heating, kWh/month	132.6803	116.9074	122.6902	109.8612	107.5717	95.9919	92.0688	101.1951	101.0687	113.9257	120.6188	129.4467 (219)
Water heating fuel used												1344.0267 (219)
Annual totals kWh/year												
Space heating fuel - main system												3566.4977 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												531.9691 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 3.70 * 1004 * 1.00) =										-2971.8288		-2971.8288 (233)
Total delivered energy for all uses												2470.6646 (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	3566.4977	0.5190	1851.0123 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1344.0267	0.5190	697.5498 (264)
Space and water heating			2548.5621 (265)
Pumps and fans	0.0000	0.0000	0.0000 (267)
Energy for lighting	531.9691	0.5190	276.0919 (268)
Energy saving/generation technologies			
PV Unit	-2971.8288	0.5190	-1542.3791 (269)
Total CO2, kg/year			1282.2749 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.7100 (273)

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

DER			7.7100 ZC1
Total Floor Area		TFA	166.4200
Assumed number of occupants		N	2.9578
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			12.0311 ZC2
CO2 emissions from cooking, equation (L16)			1.1416 ZC3
Total CO2 emissions			20.8827 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			20.8827 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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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) = 0.0846 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3346 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2844 (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												
Effective ac	0.3627	0.3555	0.3484	0.3129	0.3058	0.2702	0.2702	0.2631	0.2844	0.3058	0.3200	0.3342 (22b)
Effective ac	0.5658	0.5632	0.5607	0.5489	0.5467	0.5365	0.5365	0.5346	0.5405	0.5467	0.5512	0.5558 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
TER Opaque door			2.7000	1.0000	2.7000		(26)					
TER Opening Type (Uw = 1.40)			37.2700	1.3258	49.4110		(27)					
TER Room Window (Uw = 1.70)			1.6400	1.5918	2.6105		(27a)					
Ground Floor			166.4200	0.1300	21.6346		(28a)					
External Walls	235.1200	39.9700	195.1500	0.1800	35.1270		(29a)					
Sloping Roof	29.4000		29.4000	0.1300	3.8220		(30)					
Flat Roof	141.2200	1.6400	139.5800	0.1300	18.1454		(30)					
Total net area of external elements Aum, m <sup>2</sup>			572.1600				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	133.4505	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							70.6160 (36)					
Total fabric heat loss							(33) + (36) = 204.0665 (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	88.2410	87.8427	87.4523	85.6187	85.2756	83.6786	83.6786	83.3828	84.2937	85.2756	85.9696	86.6952 (38)
Average = Sum(39)m / 12 =	292.3074	291.9092	291.5188	289.6851	289.3421	287.7450	287.7450	287.4493	288.3602	289.3421	290.0361	290.0361 (39)
HLP (average)	1.7564	1.7541	1.7517	1.7407	1.7386	1.7290	1.7290	1.7273	1.7327	1.7386	1.7428	1.7472 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Distribution loss (46)m = 0.15 x (45)m	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Water storage loss:												250.0000 (47)
Store volume												1.8903 (48)
a) If manufacturer declared loss factor is known (kWh/day):												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0208 (55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	225.2872	198.6090	208.6778	187.1969	183.5418	164.1378	157.7666	172.9400	172.5785	194.1059	205.0824	219.9111	(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													
	225.2872	198.6090	208.6778	187.1969	183.5418	164.1378	157.7666	172.9400	172.5785	194.1059	205.0824	219.9111	(64)
Heat gains from water heating, kWh/month													
	100.5769	89.2223	95.0543	87.0838	86.6966	79.4167	78.1263	83.1715	82.2232	90.2091	93.0308	98.7894	(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	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.1223	26.7544	21.7581	16.4723	12.3132	10.3953	11.2325	14.6005	19.5967	24.8825	29.0416	30.9595	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.8805	341.3866	332.5513	313.7418	289.9983	267.6827	252.7745	249.2683	258.1037	276.9132	300.6567	322.9723	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	(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)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	(71)
Water heating gains (Table 5)	135.1840	132.7713	127.7611	120.9498	116.5276	110.3010	105.0085	111.7896	114.1989	121.2489	129.2094	132.7814	(72)
Total internal gains	573.5531	571.2786	552.4368	521.5302	489.2054	458.7453	439.3818	446.0247	462.2657	493.4108	529.2740	557.0795	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
Northeast	10.5500	11.2829	0.6300	0.7000	0.7700	36.3787	(75)						
Southeast	5.7700	36.7938	0.6300	0.7000	0.7700	64.8818	(77)						
Southwest	10.9400	36.7938	0.6300	0.7000	0.7700	123.0167	(79)						
Northwest	10.0100	11.2829	0.6300	0.7000	0.7700	34.5166	(81)						
Horizontal	1.6400	26.0000	0.6300	0.7000	1.0000	16.9238	(82)						
Solar gains	275.7176	499.5195	760.4085	1067.2367	1306.7027	1345.4574	1277.1600	1091.6387	865.8447	573.0532	335.7439	232.3678	(83)
Total gains	849.2707	1070.7981	1312.8452	1588.7669	1795.9081	1804.2027	1716.5418	1537.6634	1328.1103	1066.4640	865.0179	789.4473	(84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
tau	39.5369	39.5909	39.6439	39.6969	39.7499	39.8029	39.8559	39.9089	39.9619	39.9619	39.9619	39.9619	
alpha	3.6358	3.6394	3.6429	3.6464	3.6499	3.6534	3.6569	3.6603	3.6638	3.6673	3.6708	3.6743	
util living area	0.9986	0.9964	0.9902	0.9690	0.9108	0.7942	0.6543	0.7235	0.9112	0.9854	0.9972	0.9989	(86)
MIT	18.9502	19.1531	19.5113	19.9985	20.4622	20.7914	20.9271	20.8929	20.6023	20.0019	19.3859	18.9151	(87)
Th 2	19.5006	19.5023	19.5040	19.5118	19.5133	19.5201	19.5201	19.5214	19.5175	19.5133	19.5103	19.5072	(88)
util rest of house	0.9980	0.9951	0.9862	0.9548	0.8655	0.6826	0.4708	0.5471	0.8447	0.9765	0.9959	0.9985	(89)
MIT 2	16.8243	17.1218	17.6445	18.3497	18.9860	19.3824	19.4961	19.4795	19.1884	18.3655	17.4678	16.7770	(90)
Living area fraction									fLA = Living area / (4) =				0.4807 (91)
MIT	17.8462	18.0983	18.5419	19.1423	19.6957	20.0597	20.1840	20.1589	19.8681	19.1521	18.3899	17.8048	(92)
Temperature adjustment													0.0000
adjusted MIT	17.8462	18.0983	18.5419	19.1423	19.6957	20.0597	20.1840	20.1589	19.8681	19.1521	18.3899	17.8048	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	846.7955	1063.4577	1289.7637	1509.3968	1566.5940	1314.8961	961.6333	972.0219	1148.0555	1038.0958	860.1106	787.6839	(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	3959.6660	3852.6949	3510.4501	2967.0435	2313.4800	1570.9975	1031.2677	1080.4998	1663.2892	2474.4908	3274.4664	3955.7589	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	2315.9757	1874.3674	1652.1906	1049.5056	555.6832	0.0000	0.0000	0.0000	0.0000	1068.6779	1738.3362	2357.0479	(98)
Space heating												12611.7845	(98)
Space heating per m2													(98) / (4) = 75.7829 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													13488.5395 (211)
Space heating requirement	2315.9757	1874.3674	1652.1906	1049.5056	555.6832	0.0000	0.0000	0.0000	0.0000	1068.6779	1738.3362	2357.0479	(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)	2476.9794	2004.6710	1767.0488	1122.4659	594.3136	0.0000	0.0000	0.0000	0.0000	1142.9710	1859.1831	2520.9068	(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	225.2872	198.6090	208.6778	187.1969	183.5418	164.1378	157.7666	172.9400	172.5785	194.1059	205.0824	219.9111	(64)
Efficiency of water heater (217)m	89.4369	89.3521	89.1594	88.6997	87.5842	79.8000	79.8000	79.8000	79.8000	88.6724	89.2373	89.4762	(216)
Fuel for water heating, kWh/month	251.8952	222.2768	234.0503	211.0456	209.5605	205.6865	197.7026	216.7168	216.2638	218.9023	229.8168	245.7762	(219)
Water heating fuel used													2659.6931 (219)
Annual totals kWh/year													
Space heating fuel - main system													13488.5395 (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)													531.9691 (232)
Total delivered energy for all uses													16755.2016 (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	13488.5395	0.2160	2913.5245 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2659.6931	0.2160	574.4937 (264)
Space and water heating			3488.0182 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	531.9691	0.5190	276.0919 (268)
Total CO2, kg/m2/year			3803.0352 (272)
Emissions per m2 for space and water heating			20.9591 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			1.6590 (272b)
Emissions per m2 for pumps and fans			0.2339 (272c)
Target Carbon Dioxide Emission Rate (TER) = (20.9591 * 1.55) + 1.6590 + 0.2339, rounded to 2 d.p.			34.3800 (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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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) = 0.0846 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.2846 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2419 (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												
Effective ac	0.3085	0.3024	0.2964	0.2661	0.2601	0.2298	0.2298	0.2238	0.2419	0.2601	0.2722	0.2843 (22b)
Effective ac	0.5476	0.5457	0.5439	0.5354	0.5338	0.5264	0.5264	0.5250	0.5293	0.5338	0.5370	0.5404 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	202.8398	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							83.9220 (36)
Total fabric heat loss						(33) + (36) =	286.7618 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	85.4049	85.1168	84.8343	83.5077	83.2595	82.1041	82.1041	81.8901	82.5491	83.2595	83.7616	84.2866 (38)
Heat transfer coeff	372.1667	371.8786	371.5961	370.2695	370.0213	368.8658	368.8658	368.6519	369.3109	370.0213	370.5234	371.0484 (39)
Average = Sum(39)m / 12 =												370.2683 (39)
HLP	2.2363	2.2346	2.2329	2.2249	2.2234	2.2165	2.2165	2.2152	2.2191	2.2234	2.2264	2.2296 (40)
HLP (average)												2.2249 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water 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 (46)
Total storage loss												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	0.0000	(56)
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	0.0000	(57)
Heat gains from water heating, kWh/month	36.2058	31.6659	32.6763	28.4880	27.3349	23.5880	21.8577	25.0821	25.3816	29.5798	32.2887	35.0634		(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	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.1223	26.7544	21.7581	16.4723	12.3132	10.3953	11.2325	14.6005	19.5967	24.8825	29.0416	30.9595	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.8805	341.3866	332.5513	313.7418	289.9983	267.6827	252.7745	249.2683	258.1037	276.9132	300.6567	322.9723	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	(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)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	(71)
Water heating gains (Table 5)	48.6638	47.1218	43.9198	39.5667	36.7405	32.7611	29.3787	33.7124	35.2522	39.7578	44.8454	47.1283	(72)
Total internal gains	484.0328	482.6291	465.5954	437.1471	406.4183	378.2054	360.7520	364.9475	380.3189	408.9198	441.9100	468.4263	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	26.0100	11.2829	0.5700	0.7000	0.7700	81.1463	(75)						
Southwest	2.9700	36.7938	0.5700	0.7000	0.7700	30.2160	(79)						
Northeast	7.8300	11.2829	0.6300	0.7000	0.7700	26.9995	(75)						
Southeast	18.5000	36.7938	0.6300	0.7000	0.7700	208.0265	(77)						
Southwest	32.1400	36.7938	0.6300	0.7000	0.7700	361.4038	(79)						
Northwest	32.1300	11.2829	0.6300	0.7000	0.7700	110.7911	(81)						
Horizontal	5.2800	26.0000	0.5700	0.7000	1.0000	49.2972	(82)						
Solar gains	867.8805	1569.4586	2382.4953	3334.6721	4076.1145	4194.4295	3982.5361	3408.2507	2709.6728	1798.6480	1056.2870	731.7842	(83)
Total gains	1351.9133	2052.0876	2848.0907	3771.8192	4482.5328	4572.6349	4343.2881	3773.1982	3089.9918	2207.5678	1498.1970	1200.2105	(84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains for living area, nil,m (see Table 9a)	tau	31.0531	31.0772	31.1008	31.2123	31.2332	31.3310	31.3492	31.2933	31.2332	31.1909	31.1467	21.0000	(85)
alpha	3.0702	3.0718	3.0734	3.0808	3.0822	3.0887	3.0887	3.0899	3.0862	3.0822	3.0794	3.0764		
util living area	0.9928	0.9752	0.9282	0.8156	0.6481	0.4815	0.3623	0.4277	0.6784	0.9142	0.9841	0.9949	(86)	
MIT	18.7042	19.1216	19.7063	20.3374	20.7469	20.9249	20.9766	20.9612	20.7864	20.1362	19.2656	18.6234	(87)	
Th 2	19.1804	19.1815	19.1826	19.1876	19.1885	19.1929	19.1929	19.1937	19.1912	19.1885	19.1866	19.1847	(88)	
util rest of house	0.9900	0.9662	0.9034	0.7587	0.5558	0.3595	0.2186	0.2693	0.5493	0.8717	0.9769	0.9930	(89)	
MIT 2	17.2019	17.6132	18.1740	18.7404	19.0566	19.1690	19.1896	19.1873	19.1048	18.5968	17.7642	17.1246	(90)	
Living area fraction	17.9241	18.3383	18.9106	19.5081	19.8692	20.0131	20.0487	20.0401	19.9132	19.3368	18.4859	17.8451	(92)	
Temperature adjustment	adjusted MIT	17.9241	18.3383	18.9106	19.5081	19.8692	20.0131	20.0487	20.0401	19.9132	19.3368	18.4859	17.8451	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	1334.7072	1971.3794	2560.0086	2904.4177	2657.3786	1906.6582	1251.6881	1305.9480	1871.7807	1933.8402	1457.7477	1189.2523	(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	5070.4387	4997.4078	4611.7355	3927.8552	3022.7694	1996.7167	1272.0894	1341.9136	2146.8794	3232.7918	4218.7555	5062.9852	(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	2779.3843	2033.4911	1526.4848	736.8750	271.8508	0.0000	0.0000	0.0000	0.0000	966.4200	1987.9256	2882.0573	(98)
Space heating												13184.4890	(98)
Space heating per m2												79.2242	(99)

#### 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3467.3390	2729.6073	2801.7543	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8916	0.9283	0.8976	0.0000	0.0000	0.0000	0.0000	(101)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3091.4801	2533.9847	2514.7862	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5411.6927	5144.0058	4490.5272	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	1670.5530	1941.8557	1469.9514	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												
Cooled fraction												5082.3601 (104)
Intermittency factor (Table 10b)												FC = cooled area / (4) = 1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	417.6383	485.4639	367.4878	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												
Space cooling per m2												1270.5900 (107)
Energy for space heating												7.6348 (108)
Energy for space cooling												79.2242 (99)
Total												7.6348 (108)
Dwelling Fabric Energy Efficiency (DFEE)												86.8590 (109)
												86.9 (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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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) = 0.0846 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3346 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2844 (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												
Effective ac	0.3627	0.3555	0.3484	0.3129	0.3058	0.2702	0.2702	0.2631	0.2844	0.3058	0.3200	0.3342 (22b)
Effective ac	0.5658	0.5632	0.5607	0.5489	0.5467	0.5365	0.5365	0.5346	0.5405	0.5467	0.5512	0.5558 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
TER Opaque door			2.7000	1.0000	2.7000		(26)					
TER Opening Type (Uw = 1.40)			37.2700	1.3258	49.4110		(27)					
TER Room Window (Uw = 1.70)			1.6400	1.5918	2.6105		(27a)					
Ground Floor			166.4200	0.1300	21.6346		(28a)					
External Walls	235.1200	39.9700	195.1500	0.1800	35.1270		(29a)					
Sloping Roof	29.4000		29.4000	0.1300	3.8220		(30)					
Flat Roof	141.2200	1.6400	139.5800	0.1300	18.1454		(30)					
Total net area of external elements Aum, m <sup>2</sup>			572.1600				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	133.4505	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							70.6160 (36)					
Total fabric heat loss							(33) + (36) = 204.0665 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	88.2410	87.8427	87.4523	85.6187	85.2756	83.6786	83.6786	83.3828	84.2937	85.2756	85.9696	86.6952 (38)
Heat transfer coeff	292.3074	291.9092	291.5188	289.6851	289.3421	287.7450	287.7450	287.4493	288.3602	289.3421	290.0361	290.7617 (39)
Average = Sum(39)m / 12 =												289.6835 (39)
HLP	1.7564	1.7541	1.7517	1.7407	1.7386	1.7290	1.7290	1.7273	1.7327	1.7386	1.7428	1.7472 (40)
HLP (average)												1.7407 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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	0.0000	(59)
Heat gains from water heating, kWh/month	36.2058	31.6659	32.6763	28.4880	27.3349	23.5880	21.8577	25.0821	25.3816	29.5798	32.2887	35.0634		(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	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	147.8876	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.1223	26.7544	21.7581	16.4723	12.3132	10.3953	11.2325	14.6005	19.5967	24.8825	29.0416	30.9595	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.8805	341.3866	332.5513	313.7418	289.9983	267.6827	252.7745	249.2683	258.1037	276.9132	300.6567	322.9723	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	37.7888	(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)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	(71)
Water heating gains (Table 5)	48.6638	47.1218	43.9198	39.5667	36.7405	32.7611	29.3787	33.7124	35.2522	39.7578	44.8454	47.1283	(72)
Total internal gains	484.0328	482.6291	465.5954	437.1471	406.4183	378.2054	360.7520	364.9475	380.3189	408.9198	441.9100	468.4263	(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
Northeast	10.5500	11.2829	0.6300	0.7000	0.7700	36.3787 (75)
Southeast	5.7700	36.7938	0.6300	0.7000	0.7700	64.8818 (77)
Southwest	10.9400	36.7938	0.6300	0.7000	0.7700	123.0167 (79)
Northwest	10.0100	11.2829	0.6300	0.7000	0.7700	34.5166 (81)
Horizontal	1.6400	26.0000	0.6300	0.7000	1.0000	16.9238 (82)

Solar gains	275.7176	499.5195	760.4085	1067.2367	1306.7027	1345.4574	1277.1600	1091.6387	865.8447	573.0532	335.7439	232.3678	(83)
Total gains	759.7504	982.1486	1226.0039	1504.3838	1713.1210	1723.6628	1637.9119	1456.5862	1246.1636	981.9730	777.6539	700.7941	(84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)	0.9990	0.9973	0.9922	0.9737	0.9209	0.8114	0.6758	0.7468	0.9245	0.9888	0.9980	0.9993	(86)
MIT	18.9049	19.1087	19.4688	19.9604	20.4325	20.7739	20.9187	20.8802	20.5726	19.9612	19.3419	18.8702	(87)
Th 2	19.5006	19.5023	19.5040	19.5118	19.5133	19.5201	19.5201	19.5214	19.5175	19.5133	19.5103	19.5072	(88)
util rest of house	0.9987	0.9963	0.9889	0.9613	0.8791	0.7031	0.4906	0.5716	0.8647	0.9818	0.9971	0.9990	(89)
MIT 2	17.6282	17.8328	18.1926	18.6823	19.1286	19.4160	19.5013	19.4884	19.2702	18.6902	18.0719	17.5982	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	18.2419	18.4461	18.8061	19.2967	19.7554	20.0688	20.1827	20.1575	19.8963	19.3012	18.6824	18.2097	(92)
Temperature adjustment	0.0000												
adjusted MIT	18.2419	18.4461	18.8061	19.2967	19.7554	20.0688	20.1827	20.1575	19.8963	19.3012	18.6824	18.2097	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	758.3733	977.4987	1209.7413	1442.5880	1520.2366	1291.1152	952.2755	956.7970	1101.6172	962.6917	774.8135	699.8525	(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	4075.3311	3954.2301	3587.4517	3011.7701	2330.7789	1573.6118	1030.8984	1080.0795	1671.4282	2517.6102	3359.3216	4073.4807	(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	2467.8166	2000.3635	1769.0165	1129.8111	603.0435	0.0000	0.0000	0.0000	0.0000	1156.8594	1860.8458	2509.9794	(98)
Space heating	13497.7358 (98)												
Space heating per m2	(98) / (4) = 81.1065 (99)												

#### 8c. Space cooling requirement

Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2704.8033	2129.3132	2184.6145	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6829	0.7654	0.7085	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1847.0087	1629.6805	1547.7860	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2123.7687	2021.6089	1815.8031	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	199.2672	291.5948	199.4047	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													690.2666 (104)
Cooled fraction									fC = cooled area / (4) =				1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	49.8168	72.8987	49.8512	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													172.5667 (107)
Space cooling per m2													1.0369 (108)
Energy for space heating													81.1065 (99)
Energy for space cooling													1.0369 (108)
Total													82.1434 (109)
Target Fabric Energy Efficiency (TFEE)													94.5 (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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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					5 * 10 = 50.0000 (7a)
Number of passive vents					5 * 10 = 50.0000 (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) =					100.0000 / (5) = 0.2116 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.4116 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3498 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.1000	3.4000 (22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7750	0.8500 (22a)
Adj infilt rate												
Effective ac	0.3324	0.3061	0.3061	0.2886	0.2974	0.2624	0.2799	0.2624	0.2536	0.2711	0.2711	0.2974 (22b)
	0.5552	0.5469	0.5469	0.5417	0.5442	0.5344	0.5392	0.5344	0.5322	0.5368	0.5368	0.5442 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	202.8398	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 83.9220 (36)  
 Total fabric heat loss (33) + (36) = 286.7618 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	86.5984	85.2920	85.2920	84.4807	84.8804	83.3532	84.0929	83.3532	83.0013	83.7171	83.7171	84.8804 (38)
Heat transfer coeff	373.3602	372.0537	372.0537	371.2425	371.6421	370.1150	370.8547	370.1150	369.7630	370.4789	370.4789	371.6421 (39)
Average = Sum(39)m / 12 =												371.1500 (39)
HLP	2.2435	2.2356	2.2356	2.2308	2.2332	2.2240	2.2284	2.2240	2.2219	2.2262	2.2262	2.2332 (40)
HLP (average)												2.2302 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Store volume												250.0000 (47)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):													1.6100 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8694 (55)
Total storage loss													
	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage													
Primary loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(57)
Total heat required for water heating calculated for each month	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)
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	(62)
Output from w/h	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181	(64)
RHI water heating demand													(64)
Heat gains from water heating, kWh/month	96.8225	85.8313	91.2999	83.4506	82.9422	75.7834	74.3719	79.4171	78.5900	86.4548	89.3975	95.0350	(65)
Total per year (kWh/year) = Sum(64)m =													2235 (64)

#### 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	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.3057	66.8859	54.3953	41.1807	30.7831	25.9884	28.0813	36.5012	48.9918	62.2064	72.6040	77.3987	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	504.2992	509.5323	496.3452	468.2714	432.8332	399.5264	377.2754	372.0423	385.2294	413.3032	448.7414	482.0482	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	(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)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	(71)
Water heating gains (Table 5)	130.1378	127.7251	122.7149	115.9036	111.4814	105.2548	99.9623	106.7434	109.1527	116.2026	124.1632	127.7352	(72)
Total internal gains	824.6020	819.0025	788.3146	740.2149	689.9570	645.6288	620.1783	630.1462	658.2332	706.5715	760.3678	802.0414	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
Northeast	26.0100	12.9148	0.5700	0.7000	0.7700	92.8824 (75)							
Southwest	2.9700	40.2665	0.5700	0.7000	0.7700	33.0679 (79)							
Northeast	7.8300	12.9148	0.6300	0.7000	0.7700	30.9044 (75)							
Southeast	18.5000	40.2665	0.6300	0.7000	0.7700	227.6603 (77)							
Southwest	32.1400	40.2665	0.6300	0.7000	0.7700	395.5137 (79)							
Northwest	32.1300	12.9148	0.6300	0.7000	0.7700	126.8147 (81)							
Horizontal	5.2800	30.0000	0.5700	0.7000	1.0000	56.8814 (82)							
Solar gains	963.7249	1517.4336	2349.2351	3399.3480	4070.2386	4469.4787	4234.5027	3695.5527	2910.1956	1929.5492	1171.9005	804.0905	(83)
Total gains	1788.3269	2336.4361	3137.5497	4139.5629	4760.1956	5115.1075	4854.6810	4325.6989	3568.4289	2636.1207	1932.2684	1606.1319	(84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
tau	30.9539	31.0626	31.0626	31.1304	31.0970	31.2253	31.1630	31.2253	31.2550	31.1946	31.1946	31.0970	
alpha	3.0636	3.0708	3.0708	3.0754	3.0731	3.0817	3.0775	3.0817	3.0837	3.0796	3.0796	3.0731	
util living area	0.9806	0.9580	0.8895	0.7352	0.5327	0.3186	0.1900	0.2291	0.5218	0.8353	0.9602	0.9857	(86)
Tweekday	17.3265	17.6733	18.2624	18.7789	19.0022	19.0576	19.0573	19.0602	19.0387	18.7153	17.9308	17.2363	
Tweekend	20.0314	20.1883	20.4675	20.7395	20.8859	20.9354	20.9424	20.9416	20.9043	20.6844	20.3000	19.9887	
24 / 16	7	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	5	15	0	0	0	0	0	0	0	0	0	22	
MIT	20.7813	20.0773	20.1781	20.5933	20.8239	20.9007	20.9111	20.9099	20.8505	20.5130	19.9070	19.9887	(87)
Th 2	19.1760	19.1809	19.1809	19.1839	19.1824	19.1882	19.1854	19.1882	19.1895	19.1868	19.1868	19.1824	(88)
util rest of house	0.9730	0.9425	0.8512	0.6586	0.4226	0.1935	0.0524	0.0760	0.3699	0.7586	0.9419	0.9800	(89)
Tweekday	17.3265	17.6733	18.2624	18.7789	19.0022	19.0576	19.0573	19.0602	19.0387	18.7153	17.9308	17.2363	
Tweekend	17.3265	17.6733	18.2624	18.7789	19.0022	19.0576	19.0573	19.0602	19.0387	18.7153	17.9308	17.2363	
MIT 2	18.7583	17.6733	18.2624	18.7789	19.0022	19.0576	19.0573	19.0602	19.0387	18.7153	17.9308	17.2363	(90)
Living area fraction										fLA = Living area / (4) =		0.4807	(91)
MIT	19.7308	18.8289	19.1833	19.6511	19.8779	19.9436	19.9484	19.9494	19.9096	19.5795	18.8808	18.5594	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7308	18.8289	19.1833	19.6511	19.8779	19.9436	19.9484	19.9494	19.9096	19.5795	18.8808	18.5594	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9757	0.9387	0.8512	0.6803	0.4668	0.2466	0.1105	0.1408	0.4338	0.7782	0.9378	0.9774	(94)
Ext temp.	1744.8122	2193.1574	2670.7266	2816.1415	2222.0212	1261.2644	536.6149	609.1976	1548.0370	2051.3754	1812.1435	1569.8109	(95)
	5.6000	6.1000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.5000	12.0000	8.4000	5.5000	(96)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W	5275.8750	4735.8491	4197.9969	3434.4073	2370.3049	1274.5253	537.1606	610.4538	1630.5219	2808.0313	3882.9111	4853.4350 (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												
Space heating	2627.1107	1708.6888	1136.2891	445.1514	110.3231	0.0000	0.0000	0.0000	0.0000	562.9520	1490.9527	2443.0164 (98)
RHI space heating demand												10524.4842 (98)
												10524 (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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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					5 * 10 = 50.0000 (7a)
Number of passive vents					5 * 10 = 50.0000 (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) =					100.0000 / (5) = 0.2116 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.4116 (18)
Number of sides sheltered					2 (19)
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.3498 (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												
Effective ac	0.4461	0.4373	0.4286	0.3848	0.3761	0.3324	0.3324	0.3236	0.3498	0.3761	0.3936	0.4111 (22b)
	0.5995	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5524	0.5612	0.5707	0.5775	0.5845 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 202.8398		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							83.9220 (36)
Total fabric heat loss							(33) + (36) = 286.7618 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	93.5003	92.8978	92.3072	89.5333	89.0143	86.5984	86.5984	86.1510	87.5290	89.0143	90.0642	91.1619 (38)
Heat transfer coeff	380.2621	379.6596	379.0690	376.2951	375.7761	373.3602	373.3602	372.9127	374.2907	375.7761	376.8260	377.9236 (39)
Average = Sum(39)m / 12 =												376.2926 (39)
HLP	2.2850	2.2813	2.2778	2.2611	2.2580	2.2435	2.2435	2.2408	2.2491	2.2580	2.2643	2.2709 (40)
HLP (average)												2.2611 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Water storage loss:												
Store volume												250.0000 (47)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)		
Temperature factor from Table 2b												0.5400 (49)		
Enter (49) or (54) in (55)												0.8694 (55)		
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage														
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	22.5120	23.2624 (57)
Total heat required for water heating calculated for each month	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181	215.2181 (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	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)		
Output from w/h	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181	215.2181 (64)	
	Total per year (kWh/year) = Sum(64)m =											2234.5787 (64)		
Heat gains from water heating, kWh/month	96.8225	85.8313	91.2999	83.4506	82.9422	75.7834	74.3719	79.4171	78.5900	86.4548	89.3975	95.0350	95.0350 (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	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.3057	66.8859	54.3953	41.1807	30.7831	25.9884	28.0813	36.5012	48.9918	62.2064	72.6040	77.3987	77.3987 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	504.2992	509.5323	496.3452	468.2714	432.8332	399.5264	377.2754	372.0423	385.2294	413.3032	448.7414	482.0482	482.0482 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043 (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	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101 (71)
Water heating gains (Table 5)	130.1378	127.7251	122.7149	115.9036	111.4814	105.2548	99.9623	106.7434	109.1527	116.2026	124.1632	127.7352	127.7352 (72)
Total internal gains	824.6020	819.0025	788.3146	740.2149	689.9570	645.6288	620.1783	630.1462	658.2332	706.5715	760.3678	802.0414	802.0414 (73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	26.0100	11.2829	0.5700	0.7000	0.7700	81.1463 (75)							
Southwest	2.9700	36.7938	0.5700	0.7000	0.7700	30.2160 (79)							
Northeast	7.8300	11.2829	0.6300	0.7000	0.7700	26.9995 (75)							
Southeast	18.5000	36.7938	0.6300	0.7000	0.7700	208.0265 (77)							
Southwest	32.1400	36.7938	0.6300	0.7000	0.7700	361.4038 (79)							
Northwest	32.1300	11.2829	0.6300	0.7000	0.7700	110.7911 (81)							
Horizontal	5.2800	26.0000	0.5700	0.7000	1.0000	49.2972 (82)							
Solar gains	867.8805	1569.4586	2382.4953	3334.6721	4076.1145	4194.4295	3982.5361	3408.2507	2709.6728	1798.6480	1056.2870	731.7842	731.7842 (83)
Total gains	1692.4825	2388.4611	3170.8099	4074.8870	4766.0715	4840.0583	4602.7144	4038.3968	3367.9061	2505.2195	1816.6548	1533.8256	1533.8256 (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	30.3921	30.4403	30.4877	30.7124	30.7549	30.9539	30.9539	30.9910	30.8769	30.7549	30.6692	30.5801	30.5801 (86)
alpha	3.0261	3.0294	3.0325	3.0475	3.0503	3.0636	3.0636	3.0661	3.0585	3.0503	3.0446	3.0387	3.0387 (86)
util living area	0.9865	0.9638	0.9105	0.7930	0.6271	0.4632	0.3470	0.4065	0.6465	0.8892	0.9736	0.9898	0.9898 (86)
Tweekday	16.9724	17.4089	17.9943	18.5829	18.9037	19.0234	19.0440	19.0429	18.9614	18.4603	17.5919	16.8974	16.8974 (87)
Tweekend	19.8812	20.0781	20.3503	20.6421	20.8278	20.9095	20.9328	20.9264	20.8507	20.5604	20.1538	19.8451	19.8451 (87)
24 / 16	7	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	18	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	4	19	0	0	0	0	0	0	0	0	0	22	22
MIT	20.7835	20.0529	19.9973	20.4412	20.7343	20.8611	20.8963	20.8864	20.7669	20.3216	19.6787	19.8451	19.8451 (87)
Th 2	19.1501	19.1524	19.1546	19.1649	19.1669	19.1760	19.1760	19.1776	19.1725	19.1669	19.1630	19.1588	19.1588 (88)
util rest of house	0.9816	0.9513	0.8810	0.7324	0.5342	0.3434	0.2076	0.2535	0.5165	0.8382	0.9623	0.9861	0.9861 (89)
Tweekday	16.9724	17.4089	17.9943	18.5829	18.9037	19.0234	19.0440	19.0429	18.9614	18.4603	17.5919	16.8974	16.8974 (89)
Tweekend	16.9724	17.4089	17.9943	18.5829	18.9037	19.0234	19.0440	19.0429	18.9614	18.4603	17.5919	16.8974	16.8974 (89)
MIT 2	18.7286	17.4089	17.9943	18.5829	18.9037	19.0234	19.0440	19.0429	18.9614	18.4603	17.5919	16.8974	16.8974 (90)
Living area fraction	fLA = Living area / (4) =											0.4807 (91)	
MIT	19.7164	18.6799	18.9571	19.4762	19.7837	19.9068	19.9344	19.9291	19.8293	19.3550	18.5950	18.3144	18.3144 (92)
Temperature adjustment												0.0000	
adjusted MIT	19.7164	18.6799	18.9571	19.4762	19.7837	19.9068	19.9344	19.9291	19.8293	19.3550	18.5950	18.3144	18.3144 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	1664.2484	2262.4046	2781.3263	3031.6039	2705.2161	1903.4280	1228.3189	1287.2366	1911.2456	2115.8256	1739.5107	1508.9046	1508.9046 (94)
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	4.2000 (96)
Heat loss rate W													

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	5862.2776	5231.6690	4722.1139	3979.7800	3037.6587	1981.3425	1244.9385	1316.0503	2144.4350	3289.9219	4331.6330	5334.1611 (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	3123.3337	1995.3457	1443.9460	682.6868	247.3373	0.0000	0.0000	0.0000	0.0000	873.5276	1866.3280	2845.9908 (98)
Space heating per m2												13078.4960 (98)
												(98) / (4) = 78.5873 (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 %)												390.3179 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												3350.7294 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	3123.3337	1995.3457	1443.9460	682.6868	247.3373	0.0000	0.0000	0.0000	0.0000	873.5276	1866.3280	2845.9908 (98)
Space heating efficiency (main heating system 1)	390.3179	390.3179	390.3179	390.3179	390.3179	0.0000	0.0000	0.0000	0.0000	390.3179	390.3179	390.3179 (210)
Space heating fuel (main heating system)	800.2026	511.2104	369.9410	174.9053	63.3682	0.0000	0.0000	0.0000	0.0000	223.7990	478.1559	729.1469 (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	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181 (64)
Efficiency of water heater (217)m	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600 (217)
Fuel for water heating, kWh/month	132.6803	116.9074	122.6902	109.8612	107.5717	95.9919	92.0688	101.1951	101.0687	113.9257	120.6188	129.4467 (219)
Water heating fuel used												1344.0267 (219)
Annual totals kWh/year												
Space heating fuel - main system												3350.7294 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												531.9691 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 3.70 * 1004 * 1.00) =										-2971.8288		-2971.8288 (233)
Total delivered energy for all uses												2254.8963 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3350.7294	13.1900	441.9612 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1344.0267	13.1900	177.2771 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	531.9691	13.1900	70.1667 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-2971.8288	13.1900	-391.9842 (252)
Total energy cost			297.4208 (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] =	0.5908 (257)
SAP value		91.7577
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	3350.7294	0.5190	1739.0286 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1344.0267	0.5190	697.5498 (264)
Space and water heating			2436.5784 (265)
Pumps and fans	0.0000	0.0000	0.0000 (267)
Energy for lighting	531.9691	0.5190	276.0919 (268)
Energy saving/generation technologies			
PV Unit	-2971.8288	0.5190	-1542.3791 (269)
Total kg/year			1170.2912 (272)
CO2 emissions per m2			7.0300 (273)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value 92.5826  
EI rating 93 (274)  
EI band A

-----  
Calculation of stars for heating and DHW  
-----

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.25) / 3.9032 = 3.624$ , stars = 5
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.25) / 3.9032 = 0.1426$ , stars = 5
Water heating energy efficiency	$13.19 / 1.6626 = 7.933$ , stars = 2
Water heating environmental impact	$0.519 / 1.6626 = 0.3122$ , 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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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					5 * 10 = 50.0000 (7a)
Number of passive vents					5 * 10 = 50.0000 (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) =					100.0000 / (5) = 0.2116 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.4116 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3498 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.1000	3.4000 (22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7750	0.8500 (22a)
Adj infilt rate												
Effective ac	0.3324	0.3061	0.3061	0.2886	0.2974	0.2624	0.2799	0.2624	0.2536	0.2711	0.2711	0.2974 (22b)
	0.5552	0.5469	0.5469	0.5417	0.5442	0.5344	0.5392	0.5344	0.5322	0.5368	0.5368	0.5442 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	202.8398	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							83.9220 (36)
Total fabric heat loss						(33) + (36) =	286.7618 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	86.5984	85.2920	85.2920	84.4807	84.8804	83.3532	84.0929	83.3532	83.0013	83.7171	83.7171	84.8804 (38)
Heat transfer coeff	373.3602	372.0537	372.0537	371.2425	371.6421	370.1150	370.8547	370.1150	369.7630	370.4789	370.4789	371.6421 (39)
Average = Sum(39)m / 12 =												371.1500 (39)
HLP	2.2435	2.2356	2.2356	2.2308	2.2332	2.2240	2.2284	2.2240	2.2219	2.2262	2.2262	2.2332 (40)
HLP (average)												2.2302 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Store volume												250.0000 (47)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Month fracti	5275.8750	4735.8491	4197.9969	3434.4073	2370.3049	1274.5253	537.1606	610.4538	1630.5219	2808.0313	3882.9111	4853.4350 (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	2627.1107	1708.6888	1136.2891	445.1514	110.3231	0.0000	0.0000	0.0000	0.0000	562.9520	1490.9527	2443.0164 (98)
Space heating per m2												10524.4842 (98)
												(98) / (4) = 63.2405 (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 %)												390.7323 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												2693.5278 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	2627.1107	1708.6888	1136.2891	445.1514	110.3231	0.0000	0.0000	0.0000	0.0000	562.9520	1490.9527	2443.0164 (98)
Space heating efficiency (main heating system 1)	390.7323	390.7323	390.7323	390.7323	390.7323	0.0000	0.0000	0.0000	0.0000	390.7323	390.7323	390.7323 (210)
Space heating fuel (main heating system)	672.3556	437.3042	290.8101	113.9275	28.2350	0.0000	0.0000	0.0000	0.0000	144.0761	381.5790	625.2404 (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	220.5942	194.3702	203.9848	182.6553	178.8488	159.5962	153.0736	168.2470	168.0369	189.4129	200.5408	215.2181 (64)
Efficiency of water heater (217)m	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600 (217)
Fuel for water heating, kWh/month	132.6803	116.9074	122.6902	109.8612	107.5717	95.9919	92.0688	101.1951	101.0687	113.9257	120.6188	129.4467 (219)
Water heating fuel used												1344.0267 (219)
Annual totals kWh/year												
Space heating fuel - main system												2693.5278 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												531.9691 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 3.70 * 1046 * 1.00) =										-3097.2217		-3097.2217 (233)
Total delivered energy for all uses												1472.3019 (238)

#### 10a. Fuel costs - using BEDF prices (490)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2693.5278	19.4400	523.6218 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1344.0267	19.4400	261.2788 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	531.9691	19.4400	103.4148 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-3097.2217	19.4400	-602.0999 (252)
Total energy cost			286.2155 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2693.5278	0.5190	1397.9409 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1344.0267	0.5190	697.5498 (264)
Space and water heating			2095.4908 (265)
Pumps and fans	0.0000	0.0000	0.0000 (267)
Energy for lighting	531.9691	0.5190	276.0919 (268)
Energy saving/generation technologies			
PV Unit	-3097.2217	0.5190	-1607.4581 (269)
Total kg/year			764.1247 (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	2693.5278	3.0700	8269.1305 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	1344.0267	3.0700	4126.1618 (264)
Space and water heating			12395.2923 (265)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Pumps and fans	0.0000	0.0000	0.0000 (267)
Energy for lighting	531.9691	3.0700	1633.1450 (268)
Energy saving/generation technologies			
PV Unit	-3097.2217	3.0700	-9508.4706 (269)
Primary energy kWh/year			4519.9667 (272)
Primary energy kWh/m <sup>2</sup> /year			27.1600 (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	+ 1.9	-£ 103	-276 kg (36.1%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£103	1.66 kg/m <sup>2</sup>	A 94
<b>Total Savings</b>	<b>£103</b>	<b>1.66 kg/m<sup>2</sup></b>	<b>A 94</b>

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

Fuel prices for cost data on this page from database revision number 490 TEST (31 Jan 2022)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current £888	Potential £785	Saving £103
Electricity			
Space heating	£524	£524	-£0
Water heating	£261	£158	£103
Lighting	£103	£103	£0
Generated (PV)	-£602	-£602	£0
<b>Total cost of fuels</b>	<b>£286</b>	<b>£183</b>	<b>£103</b>
<b>Total cost of uses</b>	<b>£286</b>	<b>£183</b>	<b>£103</b>
Delivered energy	9 kWh/m <sup>2</sup>	6 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.8 tonnes	0.5 tonnes	0.3 tonnes
CO2 emissions per m <sup>2</sup>	5 kg/m <sup>2</sup>	3 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	27 kWh/m <sup>2</sup>	17 kWh/m <sup>2</sup>	10 kWh/m <sup>2</sup>

# 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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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					5 * 10 = 50.0000 (7a)
Number of passive vents					5 * 10 = 50.0000 (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) =					100.0000 / (5) = 0.2116 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.4116 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3498 (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	0.4461	0.4373	0.4286	0.3848	0.3761	0.3324	0.3324	0.3236	0.3498	0.3761	0.3936	0.4111 (22b)
Effective ac	0.5995	0.5956	0.5918	0.5740	0.5707	0.5552	0.5552	0.5524	0.5612	0.5707	0.5775	0.5845 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	202.8398	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							83.9220 (36)
Total fabric heat loss						(33) + (36) =	286.7618 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	93.5003	92.8978	92.3072	89.5333	89.0143	86.5984	86.5984	86.1510	87.5290	89.0143	90.0642	91.1619 (38)
Heat transfer coeff	380.2621	379.6596	379.0690	376.2951	375.7761	373.3602	373.3602	372.9127	374.2907	375.7761	376.8260	377.9236 (39)
Average = Sum(39)m / 12 =												376.2926 (39)
HLP	2.2850	2.2813	2.2778	2.2611	2.2580	2.2435	2.2435	2.2408	2.2491	2.2580	2.2643	2.2709 (40)
HLP (average)												2.2611 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Store volume												250.0000 (47)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)			
Temperature factor from Table 2b												0.5400 (49)			
Enter (49) or (54) in (55)												0.8694 (55)			
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	26.0820	26.9514	(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	23.2624	23.2624	(59)
Total heat required for water heating calculated for each month	220.5942	194.3702	202.5890	175.9017	166.0544	146.9895	140.0467	156.1505	162.6340	188.0172	200.5408	215.2181	215.2181	215.2181	(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												1.1036 (H8)			
Utilisation factor												0.5959 (H9)			
Collector performance factor												0.8793 (H10)			
Dedicated solar storage volume												75.0000 (H11)			
Effective solar volume												75.0000 (H13)			
Daily hot water demand												104.4466 (H14)			
Volume ratio Veff/V												0.7181 (H15)			
Solar storage volume factor												0.9338 (H16)			
Solar input												-887.3506 (H17)			
Solar input	-25.7314	-42.9383	-73.1289	-98.0071	-121.0795	-119.0404	-117.4673	-102.6317	-80.3812	-54.8909	-30.5211	-21.5328	-21.5328	-21.5328	(63)
Solar input (sum of months) = Sum(63)m =												-887.3506 (63)			
Output from w/h	194.8628	151.4319	129.4602	77.8946	44.9750	27.9490	22.5794	53.5188	82.2528	133.1263	170.0196	193.6854	193.6854	193.6854	(64)
Total per year (kWh/year) = Sum(64)m =												1281.7557 (64)			
Heat gains from water heating, kWh/month	96.8225	85.8313	90.1833	78.0477	72.7067	65.6981	63.9504	69.7399	74.2677	85.3382	89.3975	95.0350	95.0350	95.0350	(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)
(66)m	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.3057	66.8859	54.3953	41.1807	30.7831	25.9884	28.0813	36.5012	48.9918	62.2064	72.6040	77.3987	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	504.2992	509.5323	496.3452	468.2714	432.8332	399.5264	377.2754	372.0423	385.2294	413.3032	448.7414	482.0482	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	55.7043	(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)	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	-118.3101	(71)
Water heating gains (Table 5)	130.1378	127.7251	121.2141	108.3996	97.7241	91.2473	85.9548	93.7364	103.1495	114.7018	124.1632	127.7352	(72)
Total internal gains	824.6020	819.0025	786.8138	732.7109	676.1996	631.6213	606.1708	617.1392	652.2300	705.0707	760.3678	802.0414	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
Northeast	26.0100	11.2829	0.5700	0.7000	0.7700	81.1463 (75)							
Southwest	2.9700	36.7938	0.5700	0.7000	0.7700	30.2160 (79)							
Northeast	7.8300	11.2829	0.6300	0.7000	0.7700	26.9995 (75)							
Southeast	18.5000	36.7938	0.6300	0.7000	0.7700	208.0265 (77)							
Southwest	32.1400	36.7938	0.6300	0.7000	0.7700	361.4038 (79)							
Northwest	32.1300	11.2829	0.6300	0.7000	0.7700	110.7911 (81)							
Horizontal	5.2800	26.0000	0.5700	0.7000	1.0000	49.2972 (82)							
Solar gains	867.8805	1569.4586	2382.4953	3334.6721	4076.1145	4194.4295	3982.5361	3408.2507	2709.6728	1798.6480	1056.2870	731.7842	(83)
Total gains	1692.4825	2388.4611	3169.3091	4067.3830	4752.3142	4826.0508	4588.7069	4025.3899	3361.9029	2503.7187	1816.6548	1533.8256	(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	(85)
tau	30.3921	30.4403	30.4877	30.7124	30.7549	30.9539	30.9539	30.9910	30.8769	30.7549	30.6692	30.5801	(85)
alpha	3.0261	3.0294	3.0325	3.0475	3.0503	3.0636	3.0636	3.0661	3.0585	3.0503	3.0446	3.0387	(85)
util living area	0.9865	0.9638	0.9106	0.7936	0.6284	0.4643	0.3480	0.4077	0.6472	0.8894	0.9736	0.9898	(86)
Tweekday	16.9724	17.4089	17.9938	18.5816	18.9029	19.0232	19.0440	19.0428	18.9611	18.4598	17.5919	16.8974	(86)
Tweekend	19.8812	20.0781	20.3501	20.6414	20.8272	20.9093	20.9327	20.9263	20.8504	20.5602	20.1538	19.8451	(86)
24 / 16	7	0	0	0	0	0	0	0	0	0	0	0	(86)
24 / 9	18	0	0	0	0	0	0	0	0	0	0	0	(86)
16 / 9	4	19	0	0	0	0	0	0	0	0	0	22	(86)
MIT	20.7835	20.0529	19.9969	20.4400	20.7333	20.8607	20.8961	20.8862	20.7664	20.3212	19.6787	19.8451	(87)
Th 2	19.1501	19.1524	19.1546	19.1649	19.1669	19.1760	19.1760	19.1776	19.1725	19.1669	19.1630	19.1588	(88)
util rest of house	0.9816	0.9513	0.8811	0.7332	0.5354	0.3444	0.2082	0.2543	0.5172	0.8384	0.9623	0.9861	(89)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Tweekday	16.9724	17.4089	17.9938	18.5816	18.9029	19.0232	19.0440	19.0428	18.9611	18.4598	17.5919	16.8974
Tweekend	16.9724	17.4089	17.9938	18.5816	18.9029	19.0232	19.0440	19.0428	18.9611	18.4598	17.5919	16.8974
MIT 2	18.7286	17.4089	17.9938	18.5816	18.9029	19.0232	19.0440	19.0428	18.9611	18.4598	17.5919	16.8974 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.7164	18.6799	18.9567	19.4750	19.7828	19.9065	19.9343	19.9290	19.8289	19.3546	18.5950	18.3144 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.7164	18.6799	18.9567	19.4750	19.7828	19.9065	19.9343	19.9290	19.8289	19.3546	18.5950	18.3144 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9833	0.9472	0.8773	0.7446	0.5688	0.3943	0.2676	0.3197	0.5682	0.8447	0.9575	0.9838 (94)
Useful gains	1664.2484	2262.4046	2780.3511	3028.7002	2702.9948	1902.7817	1228.1542	1286.9478	1910.2802	2114.9615	1739.5107	1508.9046 (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	5862.2776	5231.6690	4721.9478	3979.3037	3037.3177	1981.2448	1244.9103	1316.0027	2144.2857	3289.7773	4331.6330	5334.1611 (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	3123.3337	1995.3457	1444.5479	684.4345	248.7362	0.0000	0.0000	0.0000	0.0000	874.0629	1866.3280	2845.9908 (98)
Space heating												13082.7799 (98)
Space heating per m2												(98) / (4) = 78.6130 (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 %)													390.3179 (206)
Efficiency of secondary/supplementary heating system, %													100.0000 (208)
Space heating requirement													3351.8269 (211)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3123.3337	1995.3457	1444.5479	684.4345	248.7362	0.0000	0.0000	0.0000	0.0000	874.0629	1866.3280	2845.9908 (98)	
Space heating efficiency (main heating system 1)	390.3179	390.3179	390.3179	390.3179	390.3179	0.0000	0.0000	0.0000	0.0000	390.3179	390.3179	390.3179 (210)	
Space heating fuel (main heating system)	800.2026	511.2104	370.0953	175.3531	63.7266	0.0000	0.0000	0.0000	0.0000	223.9362	478.1559	729.1469 (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	194.8628	151.4319	129.4602	77.8946	44.9750	27.9490	22.5794	53.5188	82.2528	133.1263	170.0196	193.6854 (64)	
Efficiency of water heater (217)m	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600 (216)	
Fuel for water heating, kWh/month	117.2037	91.0814	77.8661	46.8511	27.0510	16.8104	13.5808	32.1898	49.4724	80.0711	102.2613	116.4955 (219)	
Water heating fuel used	770.9345 (219)												
Annual totals kWh/year													
Space heating fuel - main system													3351.8269 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													50.0000 (231)
Electricity for lighting (calculated in Appendix L)													531.9691 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 3.70 * 1004 * 1.00) =											-2971.8288	-2971.8288 (233)	
Total delivered energy for all uses												1732.9017 (238)	

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3351.8269	13.1900	442.1060 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	770.9345	13.1900	101.6863 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	531.9691	13.1900	70.1667 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-2971.8288	13.1900	-391.9842 (252)
Total energy cost			228.5697 (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] =	0.4541 (257)
SAP value		93.6657

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	3351.8269	0.5190	1739.5982 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	770.9345	0.5190	400.1150 (264)
Space and water heating			2139.7132 (265)
Pumps and fans	50.0000	0.5190	25.9500 (267)
Energy for lighting	531.9691	0.5190	276.0919 (268)
Energy saving/generation technologies			
PV Unit	-2971.8288	0.5190	-1542.3791 (269)
Total kg/year			899.3760 (272)
CO2 emissions per m2			5.4000 (273)
EI value			94.2997
EI rating			94 (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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	166.4200 (1b)	x 2.8400 (2b)	= 472.6328 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	166.4200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 472.6328 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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					5 * 10 = 50.0000 (7a)
Number of passive vents					5 * 10 = 50.0000 (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) =					100.0000 / (5) = 0.2116 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.4116 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3498 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.1000	3.4000 (22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7750	0.8500 (22a)
Adj infilt rate												
Effective ac	0.3324	0.3061	0.3061	0.2886	0.2974	0.2624	0.2799	0.2624	0.2536	0.2711	0.2711	0.2974 (22b)
Effective ac	0.5552	0.5469	0.5469	0.5417	0.5442	0.5344	0.5392	0.5344	0.5322	0.5368	0.5368	0.5442 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Window (Uw = 0.80)			28.9800	0.7752	22.4651		(27)
Double Window (Uw = 1.40)			90.6000	1.3258	120.1136		(27)
Solid Door			2.7000	0.6000	1.6200		(26)
Rooflight (Uw = 0.80)			5.2800	0.7752	4.0930		(27a)
Ground Floor			166.4200	0.1100	18.3062		(28a)
External Walls	235.1200	122.2800	112.8400	0.1600	18.0544		(29a)
Sloping Roof	29.4000		29.4000	0.1100	3.2340		(30)
Flat Roof	141.2200	5.2800	135.9400	0.1100	14.9534		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			572.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	202.8398	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							83.9220 (36)
Total fabric heat loss						(33) + (36) =	286.7618 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	86.5984	85.2920	85.2920	84.4807	84.8804	83.3532	84.0929	83.3532	83.0013	83.7171	83.7171	84.8804 (38)
Heat transfer coeff	373.3602	372.0537	372.0537	371.2425	371.6421	370.1150	370.8547	370.1150	369.7630	370.4789	370.4789	371.6421 (39)
Average = Sum(39)m / 12 =												371.1500 (39)
HLP	2.2435	2.2356	2.2356	2.2308	2.2332	2.2240	2.2284	2.2240	2.2219	2.2262	2.2262	2.2332 (40)
HLP (average)												2.2302 (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												2.9578 (42)
Average daily hot water use (litres/day)												104.4466 (43)
Daily hot water use	114.8913	110.7134	106.5355	102.3577	98.1798	94.0019	94.0019	98.1798	102.3577	106.5355	110.7134	114.8913 (44)
Energy conte	170.3804	149.0158	153.7710	134.0613	128.6350	111.0022	102.8598	118.0332	119.4429	139.1991	151.9468	165.0043 (45)
Energy content (annual)												Total = Sum(45)m = 1643.3517 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	25.5571	22.3524	23.0656	20.1092	19.2952	16.6503	15.4290	17.7050	17.9164	20.8799	22.7920	24.7507 (46)
Store volume												250.0000 (47)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

a) If manufacturer declared loss factor is known (kWh/day):											1.6100 (48)	
Temperature factor from Table 2b											0.5400 (49)	
Enter (49) or (54) in (55)											0.8694 (55)	
Total storage loss												
26.9514 24.3432 26.9514 26.0820 26.9514 26.0820 26.9514 26.9514 26.0820 26.9514 26.0820 26.9514 (56)												
If cylinder contains dedicated solar storage												
26.9514 24.3432 26.9514 26.0820 26.9514 26.0820 26.9514 26.9514 26.0820 26.9514 26.0820 26.9514 (57)												
Primary loss											23.2624 (59)	
23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120												
Total heat required for water heating calculated for each month												
220.5942 194.3702 202.5890 175.9017 166.0544 146.9895 140.0467 156.1505 162.6340 188.0172 200.5408 215.2181 (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											1126.6858 (H5)	
Overshading factor											0.8000 (H6)	
Solar energy available											1892.8321 (H7)	
Adjustment factor for showers											1.0000 (H7a)	
Solar-to-load ratio											1.1518 (H8)	
Utilisation factor											0.5803 (H9)	
Collector performance factor											0.8793 (H10)	
Dedicated solar storage volume											75.0000 (H11)	
Effective solar volume											75.0000 (H13)	
Daily hot water demand											104.4466 (H14)	
Volume ratio Veff/V											0.7181 (H15)	
Solar storage volume factor											0.9338 (H16)	
Solar input											-901.8396 (H17)	
Solar input	-28.0040	-40.5965	-70.2130	-96.8685	-117.0120	-122.7318	-120.8547	-107.7895	-83.9029	-57.4974	-33.1688	-23.2004 (63)
Solar input (sum of months) = Sum(63)m =											-901.8396 (63)	
Output from w/h												
192.5902 153.7737 132.3760 79.0332 49.0424 24.2576 19.1920 48.3610 78.7311 130.5198 167.3720 192.0178 (64)												
Heat gains from water heating, kWh/month												
96.8225 85.8313 90.1833 78.0477 72.7067 65.6981 63.9504 69.7399 74.2677 85.3382 89.3975 95.0350 (65)												

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651	177.4651 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.3057 66.8859 54.3953 41.1807 30.7831 25.9884 28.0813 36.5012 48.9918 62.2064 72.6040 77.3987 (67)											
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	504.2992 509.5323 496.3452 468.2714 432.8332 399.5264 377.2754 372.0423 385.2294 413.3032 448.7414 482.0482 (68)											
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 55.7043 (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)	-118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 -118.3101 (71)											
Water heating gains (Table 5)	130.1378 127.7251 121.2141 108.3996 97.7241 91.2473 85.9548 93.7364 103.1495 114.7018 124.1632 127.7352 (72)											
Total internal gains	824.6020 819.0025 786.8138 732.7109 676.1996 631.6213 606.1708 617.1392 652.2300 705.0707 760.3678 802.0414 (73)											

#### 6. Solar gains

[Jan]	Area		Solar flux		g		FF		Access		Gains	
	m2		Table 6a		Specific data		Specific data		factor		W	
			W/m2		or Table 6b		or Table 6c		Table 6d			
Northeast	26.0100		12.9148		0.5700		0.7000		0.7700		92.8824 (75)	
Southwest	2.9700		40.2665		0.5700		0.7000		0.7700		33.0679 (79)	
Northeast	7.8300		12.9148		0.6300		0.7000		0.7700		30.9044 (75)	
Southeast	18.5000		40.2665		0.6300		0.7000		0.7700		227.6603 (77)	
Southwest	32.1400		40.2665		0.6300		0.7000		0.7700		395.5137 (79)	
Northwest	32.1300		12.9148		0.6300		0.7000		0.7700		126.8147 (81)	
Horizontal	5.2800		30.0000		0.5700		0.7000		1.0000		56.8814 (82)	
Solar gains	963.7249	1517.4336	2349.2351	3399.3480	4070.2386	4469.4787	4234.5027	3695.5527	2910.1956	1929.5492	1171.9005	804.0905 (83)
Total gains	1788.3269	2336.4361	3136.0489	4132.0589	4746.4383	5101.1000	4840.6735	4312.6920	3562.4257	2634.6199	1932.2684	1606.1319 (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	30.9539	31.0626	31.0626	31.1304	31.0970	31.2253	31.1630	31.2253	31.2550	31.1946	31.1946	31.0970
alpha	3.0636	3.0708	3.0708	3.0754	3.0731	3.0817	3.0775	3.0817	3.0837	3.0796	3.0796	3.0731
util living area	0.9806	0.9580	0.8896	0.7359	0.5339	0.3194	0.1906	0.2297	0.5225	0.8355	0.9602	0.9857 (86)
Tweekday	17.3265	17.6733	18.2620	18.7780	19.0018	19.0576	19.0573	19.0602	19.0386	18.7150	17.9308	17.2363
Tweekend	20.0314	20.1883	20.4672	20.7390	20.8856	20.9353	20.9424	20.9416	20.9041	20.6842	20.3000	19.9887
24 / 16	7	0	0	0	0	0	0	0	0	0	0	0
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0
16 / 9	5	15	0	0	0	0	0	0	0	0	0	22
MIT	20.7813	20.0773	20.1778	20.5924	20.8234	20.9006	20.9111	20.9099	20.8503	20.5127	19.9070	19.9887 (87)
Th 2	19.1760	19.1809	19.1809	19.1839	19.1824	19.1882	19.1854	19.1882	19.1895	19.1868	19.1868	19.1824 (88)
util rest of house	0.9730	0.9425	0.8513	0.6594	0.4236	0.1940	0.0525	0.0762	0.3705	0.7588	0.9419	0.9800 (89)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Tweekday	17.3265	17.6733	18.2620	18.7780	19.0018	19.0576	19.0573	19.0602	19.0386	18.7150	17.9308	17.2363
Tweekend	17.3265	17.6733	18.2620	18.7780	19.0018	19.0576	19.0573	19.0602	19.0386	18.7150	17.9308	17.2363
MIT 2	18.7583	17.6733	18.2620	18.7780	19.0018	19.0576	19.0573	19.0602	19.0386	18.7150	17.9308	17.2363 (90)
Living area fraction												fLA = Living area / (4) = 0.4807 (91)
MIT	19.7308	18.8289	19.1829	19.6502	19.8775	19.9435	19.9484	19.9494	19.9095	19.5792	18.8808	18.5594 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7308	18.8289	19.1829	19.6502	19.8775	19.9435	19.9484	19.9494	19.9095	19.5792	18.8808	18.5594 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9757	0.9387	0.8513	0.6810	0.4679	0.2472	0.1109	0.1413	0.4344	0.7784	0.9378	0.9774 (94)
Useful gains	1744.8122	2193.1574	2669.8428	2813.9733	2220.8816	1261.1441	536.6078	609.1819	1547.6515	2050.7109	1812.1435	1569.8109 (95)
Ext temp.	5.6000	6.1000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.5000	12.0000	8.4000	5.5000 (96)
Heat loss rate W	5275.8750	4735.8491	4197.8492	3434.0632	2370.1340	1274.5050	537.1582	610.4492	1630.4622	2807.9236	3882.9111	4853.4350 (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	2627.1107	1708.6888	1136.8368	446.4648	111.0438	0.0000	0.0000	0.0000	0.0000	563.3663	1490.9527	2443.0164 (98)
Space heating												10527.4802 (98)
Space heating per m2												(98) / (4) = 63.2585 (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 %)												390.7323 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												2694.2946 (211)
Space heating requirement	2627.1107	1708.6888	1136.8368	446.4648	111.0438	0.0000	0.0000	0.0000	0.0000	563.3663	1490.9527	2443.0164 (98)
Space heating efficiency (main heating system 1)	390.7323	390.7323	390.7323	390.7323	390.7323	0.0000	0.0000	0.0000	0.0000	390.7323	390.7323	390.7323 (210)
Space heating fuel (main heating system)	672.3556	437.3042	290.9503	114.2636	28.4194	0.0000	0.0000	0.0000	0.0000	144.1821	381.5790	625.2404 (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	192.5902	153.7737	132.3760	79.0332	49.0424	24.2576	19.1920	48.3610	78.7311	130.5198	167.3720	192.0178 (64)
Efficiency of water heater (217)m	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600	166.2600 (216)
Fuel for water heating, kWh/month	115.8368	92.4899	79.6199	47.5359	29.4974	14.5902	11.5434	29.0876	47.3542	78.5034	100.6688	115.4925 (219)
Water heating fuel used												762.2199 (219)
Annual totals kWh/year												
Space heating fuel - main system												2694.2946 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												50.0000 (231)
Electricity for lighting (calculated in Appendix L)												531.9691 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 3.70 * 1046 * 1.00) =										-3097.2217		-3097.2217 (233)
Total delivered energy for all uses												941.2618 (238)

#### 10a. Fuel costs - using BEDF prices (490)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2694.2946	19.4400	523.7709 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	762.2199	19.4400	148.1755 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	50.0000	19.4400	9.7200 (249)
Energy for lighting	531.9691	19.4400	103.4148 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-3097.2217	19.4400	-602.0999 (252)
Total energy cost			182.9813 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2694.2946	0.5190	1398.3389 (261)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	762.2199	0.5190	395.5921 (264)
Space and water heating			1793.9310 (265)
Pumps and fans	50.0000	0.5190	25.9500 (267)
Energy for lighting	531.9691	0.5190	276.0919 (268)
Energy saving/generation technologies			
PV Unit	-3097.2217	0.5190	-1607.4581 (269)
Total kg/year			488.5149 (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	2694.2946	3.0700	8271.4844 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	762.2199	3.0700	2340.0150 (264)
Space and water heating			10611.4994 (265)
Pumps and fans	50.0000	3.0700	153.5000 (267)
Energy for lighting	531.9691	3.0700	1633.1450 (268)
Energy saving/generation technologies			
PV Unit	-3097.2217	3.0700	-9508.4706 (269)
Primary energy kWh/year			2889.6738 (272)
Primary energy kWh/m2/year			17.3637 (273)

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

##### Overheating Calculation Input Data

Dwelling type	Detached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

##### Overheating Calculation

Summer ventilation heat loss coefficient	935.81 (P1)
Transmission heat loss coefficient	286.76 (37)
Summer heat loss coefficient	1222.57 (P2)

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

Solar shading	Z_blinds	Solar access	Z_overhangs	Z_summer
Orientation				
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)
Horizontal	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	26.0100	98.8453	0.5700	0.7000	0.9000	830.9103
South West	2.9700	119.9223	0.5700	0.7000	0.9000	115.1104
North East	7.8300	98.8453	0.6300	0.7000	0.9000	276.4657
South East	18.5000	119.9223	0.6300	0.7000	0.9000	792.4930
South West	32.1400	119.9223	0.6300	0.7000	0.9000	1376.7960
North West	32.1300	98.8453	0.6300	0.7000	0.9000	1134.4627
Horizontal	5.2800	203.0000	0.5700	0.7000	1.0000	384.8977
total:						4911.1359

	Jun	Jul	Aug	
Solar gains	5230	4911	4293	(P3)
Internal gains	646	620	630	
Total summer gains	5875	5531	4923	(P5)
Summer gain/loss ratio	4.81	4.52	4.03	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	21.06	22.67	22.08	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Assessment of likelihood of high internal temperature: Medium