

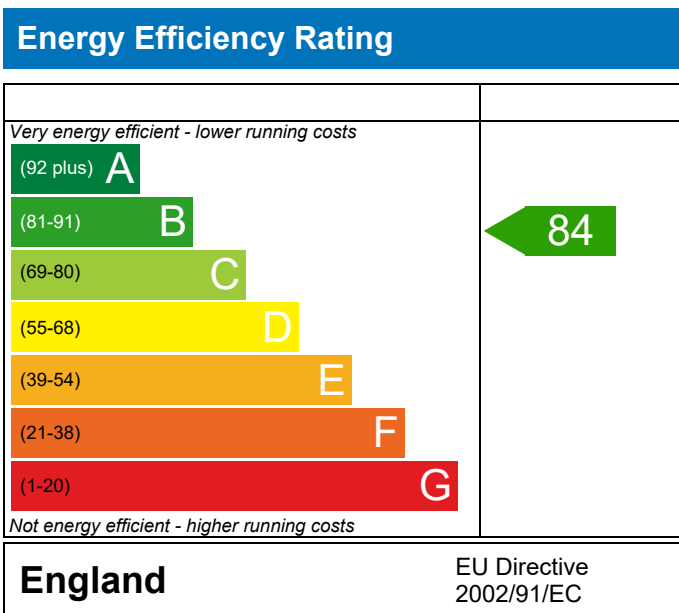
# PREDICTED ENERGY ASSESSMENT

011 - PRJ012706

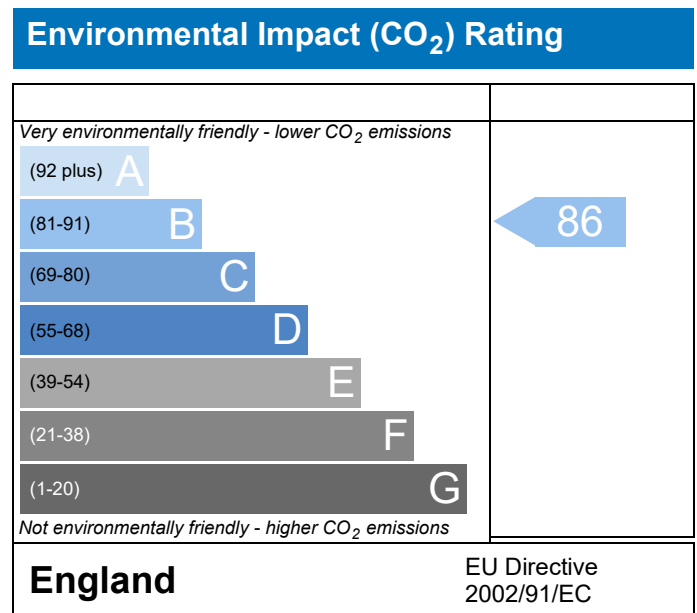
Dwelling type: House, Semi-Detached  
 Date of assessment: 27/03/2023  
 Produced by: Scott Binstead  
 Total floor area: 92.14 m<sup>2</sup>

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

Property Reference	011 - PRJ012706			Issued on Date	27/03/2023
Assessment Reference	011 S	Prop Type Ref	C		
Property	011 - PRJ012706				
SAP Rating	84 B	DER	16.75	TER	17.44
Environmental	86 B	% DER<TER	3.95		
CO <sub>2</sub> Emissions (t/year)	1.33	DFEE	44.34	TFEE	50.16
General Requirements Compliance	Pass	% DFEE<TFEE	11.59		
Assessor Details	Chris Nicholls, , Tel: ,			Assessor ID	U903-0001
Client					

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 92 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:Mains gas  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.44 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 16.75 kgCO<sub>2</sub>/m<sup>2</sup>OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 44.3 kWh/m<sup>2</sup>/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.21 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Ideal LOGIC COMBI ESP1 30

Combi boiler

Efficiency: 89.6% SEDBUK2009

Minimum: 88.0%

OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls:

No cylinder

Boiler interlock

Yes

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 (East Anglia): Slight OK

Based on:

Overshading:

Average

Windows facing North: 4.33 m<sup>2</sup>, No overhang

Windows facing East: 1.73 m<sup>2</sup>, No overhang

Windows facing South: 8.76 m<sup>2</sup>, No overhang

Air change rate: 4.55 ach

Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K

Roof U-value 0.11 W/m<sup>2</sup>K

# 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1264 (8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate					0.3769 (18)
Number of sides sheltered				1	1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3487 (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	0.4446	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3923	0.4097 (22b)
	0.5988	0.5950	0.5912	0.5736	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss							(33) + (36) = 64.1247 (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	46.8849	46.5844	46.2899	44.9068	44.6480	43.4433	43.4433	43.2202	43.9073	44.6480	45.1715	45.7188 (38)
Average = Sum(39)m / 12 =	111.0095	110.7091	110.4146	109.0314	108.7727	107.5680	107.5680	107.3449	108.0320	108.7727	109.2962	109.8435 (39)
												109.0302 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2048	1.2015	1.1983	1.1833	1.1805	1.1674	1.1674	1.1650	1.1725	1.1805	1.1862	1.1921 (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												2.6539 (42)
Average daily hot water use (litres/day)												97.2300 (43)
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy content (annual)												Total = Sum(45)m =	1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6927	13.2572	14.6428	14.1150	14.5452	14.0296	14.4683	14.5182	14.0761	14.6024	14.1826	14.6777	(61)
Total heat required for water heating calculated for each month	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)	
Output from w/h	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)
Total per year (kWh/year) = Sum(64)m =												1701.6140 (64)	
Heat gains from water heating, kWh/month	56.4104	49.4386	51.2568	45.0242	43.4522	37.8655	35.4549	40.1639	40.4897	46.7364	50.5772	54.7426	(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	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5760	20.0518	16.3072	12.3456	9.2285	7.7911	8.4185	10.9427	14.6873	18.6489	21.7660	23.2034	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.9601	245.4813	239.1280	225.6027	208.5294	192.4829	181.7629	179.2417	185.5950	199.1203	216.1936	232.2401	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	75.8204	73.5694	68.8936	62.5337	58.4035	52.5909	47.6544	53.9838	56.2357	62.8177	70.2461	73.5788	(72)
Total internal gains	407.1649	404.9108	390.1373	366.2904	341.9698	318.6733	303.6442	309.9766	322.3264	346.3953	374.0141	394.8307	(73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
North	4.3260	10.6334	0.7600	0.7000	0.7700	16.9591 (74)							
East	1.7280	19.6403	0.7600	0.7000	0.7700	12.5123 (76)							
South	8.7600	46.7521	0.7600	0.7000	0.7700	150.9906 (78)							
Solar gains	180.4619	304.1700	410.3771	503.2622	562.1996	558.3476	538.1535	493.5744	442.1461	334.3417	215.4979	154.8972	(83)
Total gains	587.6269	709.0808	800.5143	869.5526	904.1694	877.0209	841.7978	803.5510	764.4725	680.7371	589.5120	549.7279	(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	28.9431	29.0217	29.0991	29.4682	29.5383	29.8692	29.8692	29.9312	29.7409	29.5383	29.3969	29.2504	
alpha	2.9295	2.9348	2.9399	2.9645	2.9692	2.9913	2.9913	2.9954	2.9827	2.9692	2.9598	2.9500	
util living area	0.9762	0.9586	0.9303	0.8775	0.7884	0.6529	0.5134	0.5502	0.7394	0.8983	0.9620	0.9801	(86)
MIT	18.8830	19.1749	19.5813	20.0743	20.5024	20.8063	20.9312	20.9136	20.6992	20.1344	19.4169	18.8313	(87)
Th 2	19.9162	19.9188	19.9213	19.9334	19.9356	19.9461	19.9461	19.9481	19.9421	19.9356	19.9311	19.9263	(88)
util rest of house	0.9718	0.9513	0.9175	0.8537	0.7446	0.5773	0.4076	0.4459	0.6733	0.8736	0.9539	0.9765	(89)
MIT 2	17.9939	18.2831	18.6830	19.1668	19.5649	19.8311	19.9181	19.9104	19.7477	19.2348	18.5343	17.9501	(90)
Living area fraction												fLA = Living area / (4) = 0.2769 (91)	
MIT	18.2400	18.5300	18.9317	19.4180	19.8245	20.1011	20.1986	20.1881	20.0112	19.4839	18.7787	18.1941	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0900	18.3800	18.7817	19.2680	19.6745	19.9511	20.0486	20.0381	19.8612	19.3339	18.6287	18.0441	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9618	0.9376	0.9005	0.8360	0.7323	0.5777	0.4186	0.4555	0.6676	0.8564	0.9409	0.9677	(94)
Ext temp.	565.1978	664.8054	720.9023	726.9818	662.1498	506.6282	352.3659	366.0418	510.3425	582.9756	554.6688	531.9616	(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)
Month fracti	1530.8268	1492.3612	1356.0808	1130.4425	867.4024	575.6091	370.9546	390.5323	622.3894	950.0080	1260.0374	1520.6803	(97)
Space heating kWh	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	718.4279	556.1174	472.5729	290.4917	152.7080	0.0000	0.0000	0.0000	0.0000	273.0722	507.8654	735.6067	(98)
Space heating per m <sup>2</sup>												3706.8622 (98)	
												(98) / (4) = 40.2308 (99)	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4095.9804 (211)
Space heating requirement	718.4279	556.1174	472.5729	290.4917	152.7080	0.0000	0.0000	0.0000	0.0000	273.0722	507.8654	735.6067	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	793.8430	614.4944	522.1800	320.9853	168.7381	0.0000	0.0000	0.0000	0.0000	301.7372	561.1773	812.8251	(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	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)
Efficiency of water heater (217)m	89.8599	89.7936	89.6772	89.4394	88.9740	87.3000	87.3000	87.3000	87.3000	89.3680	89.7285	89.8866	(217)
Fuel for water heating, kWh/month	192.8568	169.2515	175.9524	155.3157	150.9344	134.4355	126.2556	142.4925	143.4894	161.3371	173.4463	187.2151	(219)
Water heating fuel used													1912.9821 (219)
Annual totals kWh/year													
Space heating fuel - main system													4095.9804 (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)													398.6990 (232)
Total delivered energy for all uses													6482.6615 (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	4095.9804	0.2160	884.7318	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1912.9821	0.2160	413.2041	(264)
Space and water heating			1297.9359	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.6990	0.5190	206.9248	(268)
Total CO2, kg/year			1543.7857	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7500	(273)

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

DER			16.7500	ZC1
Total Floor Area		TFA	92.1400	
Assumed number of occupants		N	2.6539	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			15.6255	ZC2
CO2 emissions from cooking, equation (L16)			1.9828	ZC3
Total CO2 emissions			34.3582	ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000	ZC5
Additional allowable electricity generation, kWh/m <sup>2</sup> /year			0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	ZC7
Net CO2 emissions			34.3582	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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1264 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3764 (18)
Number of sides sheltered				1	1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3482 (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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4091 (22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			14.8100	1.3258	19.6477		(27)
Flr - Ground			46.0700	0.1300	5.9891		(28a)
Wl - Brick	96.8040	16.9620	79.8420	0.1800	14.3716		(29a)
Wl - Clad	1.9960		1.9960	0.1800	0.3593		(29a)
Rf - Ins Joist	46.0660		46.0660	0.1300	5.9886		(30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	48.5062	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.8839 (36)  
 Total fabric heat loss (33) + (36) = 58.3901 (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
Jan	46.8643	46.5647	46.2710	44.8915	44.6334	43.4319	43.4319	43.2094	43.8947	44.6334	45.1555	45.7014 (38)
Heat transfer coeff	105.2545	104.9549	104.6611	103.2816	103.0235	101.8220	101.8220	101.5995	102.2848	103.0235	103.5457	104.0915 (39)
Average = Sum(39)m / 12 =												103.2804 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1423	1.1391	1.1359	1.1209	1.1181	1.1051	1.1051	1.1027	1.1101	1.1181	1.1238	1.1297 (40)
HLP (average)												1.1209 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6539 (42)  
 Average daily hot water use (litres/day) 97.2300 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)
Energy content (annual)												Total = Sum(45)m = 1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405 (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 EMISSIONS 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	0.0000	(57)
Combi loss	50.9589	46.0274	50.5383	46.9900	46.5745	43.1541	44.5926	46.5745	46.9900	50.5383	49.3151	50.9589	50.9589	50.9589	(61)
Total heat required for water heating calculated for each month	209.5671	184.7471	193.6846	171.7885	166.3215	146.4867	140.3454	156.4523	158.1801	180.1196	190.7632	204.5624	204.5624	204.5624	(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	209.5671	184.7471	193.6846	171.7885	166.3215	146.4867	140.3454	156.4523	158.1801	180.1196	190.7632	204.5624	204.5624	204.5624	(64)
Heat gains from water heating, kWh/month	65.4769	57.6311	60.2307	53.2430	51.4595	45.1466	42.9860	48.1780	48.7182	55.7204	59.3603	63.8129	63.8129	63.8129	(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	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5760	20.0518	16.3072	12.3456	9.2285	7.7911	8.4185	10.9427	14.6873	18.6489	21.7660	23.2034	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.9601	245.4813	239.1280	225.6027	208.5294	192.4829	181.7629	179.2417	185.5950	199.1203	216.1936	232.2401	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	88.0066	85.7606	80.9553	73.9486	69.1660	62.7036	57.7768	64.7554	67.6642	74.8930	82.4448	85.7700	(72)
Total internal gains	419.3512	417.1021	402.1989	377.7053	352.7323	328.7860	313.7666	320.7482	333.7548	358.4706	386.2128	407.0220	(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					
North	4.3260	10.6334	0.6300	0.6300	0.7000	0.7700	14.0582	(74)					
East	1.7280	19.6403	0.6300	0.6300	0.7000	0.7700	10.3720	(76)					
South	8.7600	46.7521	0.6300	0.6300	0.7000	0.7700	125.1632	(78)					
Solar gains	149.5934	252.1409	340.1810	417.1779	466.0339	462.8408	446.1010	409.1472	366.5158	277.1517	178.6364	128.4016	(83)
Total gains	568.9446	669.2430	742.3799	794.8832	818.7662	791.6268	759.8676	729.8954	700.2707	635.6223	564.8492	535.4236	(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)	60.7918	60.9654	61.1364	61.9530	62.1082	62.8411	62.8411	62.9787	62.5568	62.1082	61.7951	61.4710	(85)
tau	5.0528	5.0644	5.0758	5.1302	5.1405	5.1894	5.1894	5.1986	5.1705	5.1405	5.1197	5.0981	
alpha	0.9977	0.9944	0.9863	0.9619	0.8953	0.7474	0.5734	0.6161	0.8412	0.9711	0.9949	0.9983	(86)
util living area	19.7853	19.9539	20.1974	20.5029	20.7692	20.9384	20.9873	20.9818	20.8802	20.5343	20.1015	19.7578	(87)
MIT	19.9664	19.9690	19.9716	19.9838	19.9861	19.9967	19.9967	19.9987	19.9926	19.9861	19.9815	19.9766	(88)
util rest of house	0.9970	0.9926	0.9814	0.9473	0.8541	0.6585	0.4509	0.4940	0.7693	0.9571	0.9929	0.9978	(89)
MIT 2	18.3492	18.5969	18.9518	19.3958	19.7543	19.9542	19.9919	19.9910	19.8963	19.4475	18.8219	18.3164	(90)
Living area fraction	18.7468	18.9726	19.2966	19.7024	20.0353	20.2267	20.2675	20.2653	20.1687	19.7484	19.1762	18.7155	(92)
Temperature adjustment	18.7468	18.9726	19.2966	19.7024	20.0353	20.2267	20.2675	20.2653	20.1687	19.7484	19.1762	18.7155	(93)
adjusted MIT	18.7468	18.9726	19.2966	19.7024	20.0353	20.2267	20.2675	20.2653	20.1687	19.7484	19.1762	18.7155	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9956	0.9900	0.9771	0.9423	0.8564	0.6805	0.4851	0.5279	0.7836	0.9528	0.9906	0.9967	(94)
Ext temp.	566.4591	662.5445	725.3506	748.9952	701.2093	538.7407	368.6126	385.3233	548.7041	605.6369	559.5116	533.6756	(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)
Month fracti	1520.5932	1476.9873	1339.3092	1115.6845	858.7306	572.9207	373.4304	392.7147	620.7358	942.5032	1250.4380	1510.9392	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(97a)
Space heating	709.8758	547.3055	456.7852	264.0163	117.1959	0.0000	0.0000	0.0000	0.0000	250.6285	497.4670	727.0842	(98)
Space heating per m2												3570.3584	(98)
												38.7493	(99)

#### 8c. Space cooling requirement

Not applicable



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3822.6535 (211)
Space heating requirement	709.8758	547.3055	456.7852	264.0163	117.1959	0.0000	0.0000	0.0000	0.0000	250.6285	497.4670	727.0842	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	760.0383	585.9802	489.0634	282.6727	125.4774	0.0000	0.0000	0.0000	0.0000	268.3389	532.6199	778.4627	(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	209.5671	184.7471	193.6846	171.7885	166.3215	146.4867	140.3454	156.4523	158.1801	180.1196	190.7632	204.5624	(64)
Efficiency of water heater (217)m	87.8806	87.6188	87.1366	86.1297	84.1881	80.3000	80.3000	80.3000	80.3000	85.8830	87.3545	87.9705	(216)
Fuel for water heating, kWh/month	238.4679	210.8534	222.2770	199.4533	197.5595	182.4243	174.7764	194.8347	196.9865	209.7267	218.3781	232.5353	(219)
Water heating fuel used													2478.2730 (219)
Annual totals kWh/year													
Space heating fuel - main system													3822.6535 (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)													398.6990 (232)
Total delivered energy for all uses													6774.6255 (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	3822.6535	0.2160	825.6932 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2478.2730	0.2160	535.3070 (264)
Space and water heating			1361.0001 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.6990	0.5190	206.9248 (268)
Total CO2, kg/m2/year			1606.8499 (272)
Emissions per m2 for space and water heating			14.7710 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2458 (272b)
Emissions per m2 for pumps and fans			0.4225 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7710 * 1.00) + 2.2458 + 0.4225, rounded to 2 d.p.			17.4400 (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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1264 (8)
Pressure test					Yes
Measured/design AP50					5.0100
Infiltration rate					0.3769 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3487 (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	0.4446	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3923	0.4097 (22b)
Effective ac	0.5988	0.5950	0.5912	0.5736	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss						(33) + (36) =	64.1247 (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	46.8849	46.5844	46.2899	44.9068	44.6480	43.4433	43.4433	43.2202	43.9073	44.6480	45.1715	45.7188 (38)
Average = Sum(39)m / 12 =	111.0095	110.7091	110.4146	109.0314	108.7727	107.5680	107.5680	107.3449	108.0320	108.7727	109.2962	109.8435 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2048	1.2015	1.1983	1.1833	1.1805	1.1674	1.1674	1.1650	1.1725	1.1805	1.1862	1.1921 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6539 (42)											
Average daily hot water use (litres/day)	97.2300 (43)											
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1529.8059 (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	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	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage															
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	0.0000	(57)
Heat gains from water heating, kWh/month	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	(59)
	33.7042	29.4779	30.4186	26.5197	25.4462	21.9582	20.3475	23.3490	23.6279	27.5360	30.0577	32.6407	32.6407	32.6407	(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	
	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5760	20.0518	16.3072	12.3456	9.2285	7.7911	8.4185	10.9427	14.6873	18.6489	21.7660	23.2034	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	242.9601	245.4813	239.1280	225.6027	208.5294	192.4829	181.7629	179.2417	185.5950	199.1203	216.1936	232.2401	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	(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)													
	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)													
	45.3014	43.8660	40.8852	36.8329	34.2019	30.4975	27.3488	31.3831	32.8165	37.0108	41.7468	43.8720	(72)
Total internal gains	373.6459	372.2075	359.1289	337.5896	314.7682	293.5799	280.3386	284.3759	295.9072	317.5884	342.5149	362.1239	(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				
North	4.3260	10.6334	0.7600	0.7000	0.7700	16.9591	(74)						
East	1.7280	19.6403	0.7600	0.7000	0.7700	12.5123	(76)						
South	8.7600	46.7521	0.7600	0.7000	0.7700	150.9906	(78)						
Solar gains	180.4619	304.1700	410.3771	503.2622	562.1996	558.3476	538.1535	493.5744	442.1461	334.3417	215.4979	154.8972	(83)
Total gains	554.1078	676.3775	769.5059	840.8518	876.9678	851.9274	818.4921	777.9504	738.0533	651.9301	558.0127	517.0211	(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	28.9431	29.0217	29.0991	29.4682	29.5383	29.8692	29.8692	29.9312	29.7409	29.5383	29.3969	29.2504	
alpha	2.9295	2.9348	2.9399	2.9645	2.9692	2.9913	2.9913	2.9954	2.9827	2.9692	2.9598	2.9500	
util living area	0.9794	0.9631	0.9362	0.8854	0.7987	0.6650	0.5249	0.5638	0.7526	0.9071	0.9667	0.9830	(86)
MIT	18.8319	19.1279	19.5410	20.0434	20.4818	20.7961	20.9269	20.9076	20.6829	20.1008	19.3709	18.7806	(87)
Th 2	19.9162	19.9188	19.9213	19.9334	19.9356	19.9461	19.9461	19.9481	19.9421	19.9356	19.9311	19.9263	(88)
util rest of house	0.9756	0.9564	0.9243	0.8627	0.7560	0.5895	0.4178	0.4584	0.6877	0.8840	0.9596	0.9799	(89)
MIT 2	17.9435	18.2374	18.6445	19.1386	19.5478	19.8243	19.9161	19.9074	19.7357	19.2042	18.4896	17.9000	(90)
Living area fraction													
	fLA = Living area / (4) = 0.2769 (91)												
MIT	18.1895	18.4839	18.8927	19.3891	19.8064	20.0934	20.1960	20.1844	19.9980	19.4524	18.7336	18.1438	(92)
Temperature adjustment													
adjusted MIT	18.1895	18.4839	18.8927	19.3891	19.8064	20.0934	20.1960	20.1844	19.9980	19.4524	18.7336	18.1438	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9675	0.9449	0.9101	0.8490	0.7501	0.6010	0.4447	0.4837	0.6915	0.8712	0.9490	0.9727	(94)
Useful gains	536.0771	639.0995	700.3449	713.8911	657.8071	511.9727	363.9925	376.2779	510.3790	567.9360	529.5646	502.9192	(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	1541.8658	1503.8653	1368.3360	1143.6422	881.7517	590.9099	386.8126	406.2319	637.1682	962.9013	1271.5072	1531.6353	(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	748.3068	581.1226	496.9854	309.4208	166.6148	0.0000	0.0000	0.0000	0.0000	293.8542	534.1987	765.3648	(98)
Space heating													
Space heating per m2	(98) / (4) = 42.2820 (99)												

#### 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	1011.1388	796.0029	815.8209	0.0000	0.0000	0.0000	0.0000	(100)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7790	0.8435	0.8232	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	787.6467	671.4475	671.6018	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1096.5323	1055.3487	1009.8252	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	222.3976	285.6225	251.6382	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												
Cooled fraction									FC = cooled area / (4) =			759.6584 (104)
Intermittency factor (Table 10b)												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	55.5994	71.4056	62.9096	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												
Space cooling per m2												189.9146 (107)
Energy for space heating												2.0612 (108)
Energy for space cooling												42.2820 (99)
Total												2.0612 (108)
Dwelling Fabric Energy Efficiency (DFEE)												44.3432 (109)
												44.3 (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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				30.0000 / (5) =	0.1264 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3764 (18)
Number of sides sheltered				1	1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3482 (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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4091 (22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			14.8100	1.3258	19.6477		(27)
Flr - Ground			46.0700	0.1300	5.9891		(28a)
Wl - Brick	96.8040	16.9620	79.8420	0.1800	14.3716		(29a)
Wl - Clad	1.9960		1.9960	0.1800	0.3593		(29a)
Rf - Ins Joist	46.0660		46.0660	0.1300	5.9886		(30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	48.5062	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.8839 (36)  
 Total fabric heat loss (33) + (36) = 58.3901 (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	46.8643	46.5647	46.2710	44.8915	44.6334	43.4319	43.4319	43.2094	43.8947	44.6334	45.1555	45.7014 (38)
Average = Sum(39)m / 12 =	105.2545	104.9549	104.6611	103.2816	103.0235	101.8220	101.8220	101.5995	102.2848	103.0235	103.5457	104.0915 (39)
HLP (average)	1.1423	1.1391	1.1359	1.1209	1.1181	1.1051	1.1051	1.1027	1.1101	1.1181	1.1238	1.1297 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6539 (42)  
 Average daily hot water use (litres/day) 97.2300 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)
Energy content (annual)												Total = Sum(45)m = 1529.8059 (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	33.7042	29.4779	30.4186	26.5197	25.4462	21.9582	20.3475	23.3490	23.6279	27.5360	30.0577	32.6407	(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	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	132.6947	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5760	20.0518	16.3072	12.3456	9.2285	7.7911	8.4185	10.9427	14.6873	18.6489	21.7660	23.2034	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.9601	245.4813	239.1280	225.6027	208.5294	192.4829	181.7629	179.2417	185.5950	199.1203	216.1936	232.2401	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	36.2695	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	45.3014	43.8660	40.8852	36.8329	34.2019	30.4975	27.3488	31.3831	32.8165	37.0108	41.7468	43.8720	(72)
Total internal gains	373.6459	372.2075	359.1289	337.5896	314.7682	293.5799	280.3386	284.3759	295.9072	317.5884	342.5149	362.1239	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
North	4.3260	10.6334	0.6300	0.7000	0.7700	14.0582 (74)							
East	1.7280	19.6403	0.6300	0.7000	0.7700	10.3720 (76)							
South	8.7600	46.7521	0.6300	0.7000	0.7700	125.1632 (78)							
Solar gains	149.5934	252.1409	340.1810	417.1779	466.0339	462.8408	446.1010	409.1472	366.5158	277.1517	178.6364	128.4016	(83)
Total gains	523.2393	624.3484	699.3098	754.7674	780.8021	756.4206	726.4395	693.5232	662.4230	594.7401	521.1513	490.5255	(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)	60.7918	60.9654	61.1364	61.9530	62.1082	62.8411	62.8411	62.9787	62.5568	62.1082	61.7951	61.4710	(85)
tau	5.0528	5.0644	5.0758	5.1302	5.1405	5.1894	5.1894	5.1986	5.1705	5.1405	5.1197	5.0981	
util living area	0.9985	0.9959	0.9893	0.9688	0.9097	0.7702	0.5965	0.6430	0.8633	0.9778	0.9965	0.9989	(86)
MIT	19.7391	19.9093	20.1562	20.4687	20.7459	20.9290	20.9849	20.9780	20.8625	20.4977	20.0578	19.7122	(87)
Th 2	19.9664	19.9690	19.9716	19.9838	19.9861	19.9967	19.9967	19.9987	19.9926	19.9861	19.9815	19.9766	(88)
util rest of house	0.9979	0.9945	0.9854	0.9564	0.8721	0.6825	0.4707	0.5181	0.7959	0.9667	0.9950	0.9985	(89)
MIT 2	18.8163	18.9879	19.2350	19.5504	19.8090	19.9625	19.9927	19.9922	19.9151	19.5841	19.1465	18.7977	(90)
Living area fraction	19.0718	19.2430	19.4901	19.8047	20.0684	20.2301	20.2674	20.2651	20.1774	19.8371	19.3988	19.0509	(91)
MIT	19.0718	19.2430	19.4901	19.8047	20.0684	20.2301	20.2674	20.2651	20.1774	19.8371	19.3988	19.0509	(92)
Temperature adjustment													0.0000
adjusted MIT	19.0718	19.2430	19.4901	19.8047	20.0684	20.2301	20.2674	20.2651	20.1774	19.8371	19.3988	19.0509	(93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9932	0.9831	0.9537	0.8756	0.7048	0.5060	0.5531	0.8102	0.9646	0.9939	0.9980	(94)
Useful gains	521.8226	620.0906	687.4744	719.8195	683.7026	533.1228	367.5839	383.5671	536.6813	573.6579	517.9625	489.5620	(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	1554.7959	1505.3690	1359.5541	1126.2524	862.1386	573.2698	373.4207	392.6912	621.6260	951.6342	1273.4875	1545.8495	(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	768.5321	594.9071	500.0273	292.6317	132.7564	0.0000	0.0000	0.0000	0.0000	281.2144	543.9780	785.8779	(98)
Space heating												3899.9249	(98)
Space heating per m2										(98) / (4) =		42.3261	(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	957.1271	753.4830	772.1564	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8502	0.9178	0.8994	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	813.7320	691.5386	694.4988	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	984.9009	947.7548	911.1440	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	123.2416	190.6248	161.1841	0.0000	0.0000	0.0000	0.0000	(104)

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## Calculation Type: New Build (As Designed)

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

Space cooling												475.0505 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	30.8104	47.6562	40.2960	0.0000	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												118.7626 (107)
Space cooling per m2												1.2889 (108)
Energy for space heating												42.3261 (99)
Energy for space cooling												1.2889 (108)
Total												43.6150 (109)
Target Fabric Energy Efficiency (TFEE)												50.2 (109)

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# 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				30.0000 / (5) =	0.1264 (8)
Pressure test				Yes	
Measured/design AP50					5.0100
Infiltration rate					0.3769 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3487 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.9000	4.8000	4.7000	4.2000	4.2000	3.7000	3.8000	3.8000	4.0000	4.2000	4.3000	4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infilt rate												
Effective ac	0.4271	0.4184	0.4097	0.3661	0.3661	0.3225	0.3312	0.3312	0.3487	0.3661	0.3748	0.3923 (22b)
	0.5912	0.5875	0.5839	0.5670	0.5670	0.5520	0.5549	0.5549	0.5608	0.5670	0.5702	0.5769 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss						(33) + (36) =	64.1247 (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	46.2899	46.0014	45.7188	44.3951	44.3951	43.2202	43.4433	43.4433	43.9073	44.3951	44.6480	45.1715 (38)
Average = Sum(39)m / 12 =	110.4146	110.1261	109.8435	108.5198	108.5198	107.3449	107.5680	107.5680	108.0320	108.5198	108.7727	109.2962 (39)
HLP	1.1983	1.1952	1.1921	1.1778	1.1778	1.1650	1.1674	1.1674	1.1725	1.1778	1.1805	1.1862 (40)
HLP (average)												1.1798 (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												2.6539 (42)
Average daily hot water use (litres/day)												97.2300 (43)
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)



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### CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6927	13.2572	14.6428	14.1150	14.5452	14.0296	14.4683	14.5182	14.0761	14.6024	14.1826	14.6777	(61)
Total heat required for water heating calculated for each month	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)	
Output from w/h	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)
Total per year (kWh/year) = Sum(64)m =												1701.6140 (64)	
RHI water heating demand												1702 (64)	
Heat gains from water heating, kWh/month	56.4104	49.4386	51.2568	45.0242	43.4522	37.8655	35.4549	40.1639	40.4897	46.7364	50.5772	54.7426	(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	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4400	50.1295	40.7680	30.8640	23.0712	19.4777	21.0463	27.3568	36.7183	46.6223	54.4151	58.0086	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	362.6271	366.3900	356.9075	336.7205	311.2379	287.2879	271.2879	267.5249	277.0074	297.1945	322.6770	346.6270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	75.8204	73.5694	68.8936	62.5337	58.4035	52.5909	47.6544	53.9838	56.2357	62.8177	70.2461	73.5788	(72)
Total internal gains	604.5426	599.7440	576.2243	539.7733	502.3678	469.0117	449.6437	458.5206	479.6165	516.2896	556.9933	587.8695	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	Specific data	Specific data	Access	Gains							
	m2	Table 6a	g	FF	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
North	4.3260	12.0539	0.7600	0.7000	0.7700	19.2247 (74)							
East	1.7280	22.4175	0.7600	0.7000	0.7700	14.2815 (76)							
South	8.7600	51.7504	0.7600	0.7000	0.7700	167.1332 (78)							
Solar gains	200.6394	314.9837	417.9265	540.2450	584.5465	606.1126	577.9755	532.5197	477.7468	361.7929	245.4010	170.5971	(83)
Total gains	805.1820	914.7277	994.1507	1080.0183	1086.9143	1075.1242	1027.6193	991.0403	957.3634	878.0825	802.3943	758.4666	(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	29.0991	29.1753	29.2504	29.6072	29.6072	29.9312	29.8692	29.8692	29.7409	29.6072	29.5383	29.3969	
alpha	2.9399	2.9450	2.9500	2.9738	2.9738	2.9954	2.9913	2.9913	2.9827	2.9738	2.9692	2.9598	
util living area	0.9458	0.9225	0.8812	0.7996	0.6841	0.5112	0.3453	0.3570	0.5904	0.8083	0.9144	0.9525	(86)
MIT	19.2799	19.5139	19.9015	20.3593	20.7018	20.9138	20.9818	20.9801	20.8615	20.4465	19.8125	19.2390	(87)
Th 2	19.9213	19.9238	19.9263	19.9378	19.9378	19.9481	19.9461	19.9461	19.9421	19.9378	19.9356	19.9311	(88)
util rest of house	0.9366	0.9098	0.8613	0.7659	0.6289	0.4298	0.2428	0.2515	0.5098	0.7681	0.8979	0.9444	(89)
MIT 2	18.3864	18.6150	18.9908	19.4285	19.7317	19.9043	19.9413	19.9409	19.8655	19.5176	18.9189	18.3541	(90)
Living area fraction												fLA = Living area / (4) =	
MIT	18.6337	18.8639	19.2430	19.6862	20.0003	20.1838	20.2294	20.2286	20.1413	19.7748	19.1663	18.5991	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4837	18.7139	19.0930	19.5362	19.8503	20.0338	20.0794	20.0786	19.9913	19.6248	19.0163	18.4491	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9211	0.8923	0.8430	0.7515	0.6239	0.4368	0.2561	0.2651	0.5138	0.7544	0.8804	0.9299	(94)
Useful gains	741.6717	816.2166	838.0962	811.6190	678.1162	469.5716	263.1949	262.7564	491.9093	662.4565	706.4335	705.2713	(95)
Ext temp.	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000	(96)
Heat loss rate W	1521.9274	1488.2322	1328.3334	1089.1274	797.6539	497.4155	266.7044	266.6151	539.2169	892.5535	1230.9063	1502.7249	(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	580.5102	451.5945	364.7365	199.8061	88.9360	0.0000	0.0000	0.0000	0.0000	171.1922	377.6204	593.3055	(98)
Space heating												2827.7014 (98)	
RHI space heating demand												2828 (98)	

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CALCULATION OF HEAT DEMAND 09 Jan 2014

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# 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				3 * 10 =	30.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1264 (8)							
Pressure test					Yes							
Measured/design AP50					5.0100							
Infiltration rate					0.3769 (18)							
Number of sides sheltered					1 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3487 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.4446	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3923	0.4097 (22b)
	0.5988	0.5950	0.5912	0.5736	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss						(33) + (36) =	64.1247 (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	46.8849	46.5844	46.2899	44.9068	44.6480	43.4433	43.4433	43.2202	43.9073	44.6480	45.1715	45.7188 (38)
Average = Sum(39)m / 12 =	111.0095	110.7091	110.4146	109.0314	108.7727	107.5680	107.5680	107.3449	108.0320	108.7727	109.2962	109.8435 (39)
HLP	1.2048	1.2015	1.1983	1.1833	1.1805	1.1674	1.1674	1.1650	1.1725	1.1805	1.1862	1.1921 (40)
HLP (average)												1.1833 (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												2.6539 (42)
Average daily hot water use (litres/day)												97.2300 (43)
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)

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Energy content (annual)													Total = Sum(45)m =	1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m														
	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405	(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	0.0000 (56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Combi loss	14.6927	13.2572	14.6428	14.1150	14.5452	14.0296	14.4683	14.5182	14.0761	14.6024	14.1826	14.6777	(61)	
Total heat required for water heating calculated for each month	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)	
Solar input (sum of months) = Sum(63)m =	0.0000 (63)													
Output from w/h	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)	
Total per year (kWh/year) = Sum(64)m =	1701.6140 (64)													
Heat gains from water heating, kWh/month	56.4104	49.4386	51.2568	45.0242	43.4522	37.8655	35.4549	40.1639	40.4897	46.7364	50.5772	54.7426	(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	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4400	50.1295	40.7680	30.8640	23.0712	19.4777	21.0463	27.3568	36.7183	46.6223	54.4151	58.0086	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	362.6271	366.3900	356.9075	336.7205	311.2379	287.2879	271.2879	267.5249	277.0074	297.1945	322.6770	346.6270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	75.8204	73.5694	68.8936	62.5337	58.4035	52.5909	47.6544	53.9838	56.2357	62.8177	70.2461	73.5788	(72)
Total internal gains	604.5426	599.7440	576.2243	539.7733	502.3678	469.0117	449.6437	458.5206	479.6165	516.2896	556.9933	587.8695	(73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
North	4.3260	10.6334	0.7600	0.7000	0.7700	16.9591 (74)							
East	1.7280	19.6403	0.7600	0.7000	0.7700	12.5123 (76)							
South	8.7600	46.7521	0.7600	0.7000	0.7700	150.9906 (78)							
Solar gains	180.4619	304.1700	410.3771	503.2622	562.1996	558.3476	538.1535	493.5744	442.1461	334.3417	215.4979	154.8972	(83)
Total gains	785.0045	903.9140	986.6014	1043.0354	1064.5673	1027.3593	987.7973	952.0951	921.7626	850.6313	772.4911	742.7667	(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	28.9431	29.0217	29.0991	29.4682	29.5383	29.8692	29.8692	29.9312	29.7409	29.5383	29.3969	29.2504	
alpha	2.9295	2.9348	2.9399	2.9645	2.9692	2.9913	2.9913	2.9954	2.9827	2.9692	2.9598	2.9500	
util living area	0.9518	0.9278	0.8914	0.8278	0.7287	0.5864	0.4500	0.4810	0.6648	0.8430	0.9287	0.9581	(86)
MIT	19.1700	19.4379	19.8046	20.2414	20.6071	20.8562	20.9518	20.9400	20.7786	20.3101	19.6668	19.1182	(87)
Th 2	19.9162	19.9188	19.9213	19.9334	19.9356	19.9461	19.9461	19.9481	19.9421	19.9356	19.9311	19.9263	(88)
util rest of house	0.9438	0.9161	0.8735	0.7984	0.6804	0.5116	0.3529	0.3842	0.5951	0.8100	0.9151	0.9510	(89)
MIT 2	18.2747	18.5372	18.8939	19.3172	19.6499	19.8633	19.9271	19.9229	19.8042	19.3919	18.7747	18.2315	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	18.5226	18.7866	19.1460	19.5731	19.9150	20.1382	20.2108	20.2045	20.0740	19.6461	19.0217	18.4770	(92)
Temperature adjustment													-0.1500
adjusted MIT	18.3726	18.6366	18.9960	19.4231	19.7650	19.9882	20.0608	20.0545	19.9240	19.4961	18.8717	18.3270	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	729.2577	812.4579	843.5718	815.8770	715.1838	528.8477	359.4901	375.6057	547.3664	675.4441	693.8643	696.1685	(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	1562.1895	1520.7676	1379.7430	1147.3469	877.2468	579.6021	372.2735	392.2879	629.1778	967.6555	1286.5978	1551.7597	(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	619.7013	475.9847	398.9114	238.6584	120.5749	0.0000	0.0000	0.0000	0.0000	217.4053	426.7681	636.5598	(98)
Space heating													3134.5638 (98)
Space heating per m <sup>2</sup>													(98) / (4) = 34.0196 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3463.6064 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	619.7013	475.9847	398.9114	238.6584	120.5749	0.0000	0.0000	0.0000	0.0000	217.4053	426.7681	636.5598	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	684.7528	525.9499	440.7860	263.7109	133.2319	0.0000	0.0000	0.0000	0.0000	240.2268	471.5670	703.3810	(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	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)
Efficiency of water heater (217)m	89.7808	89.7042	89.5694	89.2958	88.7852	87.3000	87.3000	87.3000	87.3000	89.1963	89.6221	89.8117	(217)
Fuel for water heating, kWh/month	193.0267	169.4201	176.1640	155.5656	151.2553	134.4355	126.2556	142.4925	143.4894	161.6477	173.6522	187.3712	(219)
Water heating fuel used													1914.7757 (219)
Annual totals kWh/year													
Space heating fuel - main system													3463.6064 (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)													398.6990 (232)
Total delivered energy for all uses													5852.0811 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3463.6064	3.4800	120.5335 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1914.7757	3.4800	66.6342 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	398.6990	13.1900	52.5884 (250)
Additional standing charges			120.0000 (251)
Total energy cost			369.6486 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1321 (257)
SAP value		84.2076
SAP rating (Section 12)		84 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3463.6064	0.2160	748.1390 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1914.7757	0.2160	413.5915 (264)
Space and water heating			1161.7305 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.6990	0.5190	206.9248 (268)
Total kg/year			1407.5803 (272)
CO2 emissions per m2			15.2800 (273)
EI value			86.2465
EI rating			86 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$ , stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$ , stars = 4
Water heating energy efficiency	$3.48 / 0.8875 = 3.921$ , stars = 4
Water heating environmental impact	$0.216 / 0.8875 = 0.2434$ , stars = 4

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

# 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1264 (8)
Pressure test					Yes
Measured/design AP50					5.0100
Infiltration rate					0.3769 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3487 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.9000	4.8000	4.7000	4.2000	4.2000	3.7000	3.8000	3.8000	4.0000	4.2000	4.3000	4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infilt rate												
Effective ac	0.4271	0.4184	0.4097	0.3661	0.3661	0.3225	0.3312	0.3312	0.3487	0.3661	0.3748	0.3923 (22b)
	0.5912	0.5875	0.5839	0.5670	0.5670	0.5520	0.5549	0.5549	0.5608	0.5670	0.5702	0.5769 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss						(33) + (36) =	64.1247 (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	46.2899	46.0014	45.7188	44.3951	44.3951	43.2202	43.4433	43.4433	43.9073	44.3951	44.6480	45.1715 (38)
Average = Sum(39)m / 12 =	110.4146	110.1261	109.8435	108.5198	108.5198	107.3449	107.5680	107.5680	108.0320	108.5198	108.7727	109.2962 (39)
												108.7104 (39)
HLP	1.1983	1.1952	1.1921	1.1778	1.1778	1.1650	1.1674	1.1674	1.1725	1.1778	1.1805	1.1862 (40)
HLP (average)												1.1798 (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												2.6539 (42)
Average daily hot water use (litres/day)												97.2300 (43)
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy content (annual)												Total = Sum(45)m =	1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6927	13.2572	14.6428	14.1150	14.5452	14.0296	14.4683	14.5182	14.0761	14.6024	14.1826	14.6777	(61)
Total heat required for water heating calculated for each month	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)	
Output from w/h	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)
Total per year (kWh/year) = Sum(64)m =												1701.6140 (64)	
Heat gains from water heating, kWh/month	56.4104	49.4386	51.2568	45.0242	43.4522	37.8655	35.4549	40.1639	40.4897	46.7364	50.5772	54.7426	(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	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4400	50.1295	40.7680	30.8640	23.0712	19.4777	21.0463	27.3568	36.7183	46.6223	54.4151	58.0086	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	362.6271	366.3900	356.9075	336.7205	311.2379	287.2879	271.2879	267.5249	277.0074	297.1945	322.6770	346.6270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	75.8204	73.5694	68.8936	62.5337	58.4035	52.5909	47.6544	53.9838	56.2357	62.8177	70.2461	73.5788	(72)
Total internal gains	604.5426	599.7440	576.2243	539.7733	502.3678	469.0117	449.6437	458.5206	479.6165	516.2896	556.9933	587.8695	(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							
North	4.3260	12.0539	0.7600	0.7000	0.7700	19.2247 (74)							
East	1.7280	22.4175	0.7600	0.7000	0.7700	14.2815 (76)							
South	8.7600	51.7504	0.7600	0.7000	0.7700	167.1332 (78)							
Solar gains	200.6394	314.9837	417.9265	540.2450	584.5465	606.1126	577.9755	532.5197	477.7468	361.7929	245.4010	170.5971	(83)
Total gains	805.1820	914.7277	994.1507	1080.0183	1086.9143	1075.1242	1027.6193	991.0403	957.3634	878.0825	802.3943	758.4666	(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	29.0991	29.1753	29.2504	29.6072	29.6072	29.9312	29.8692	29.8692	29.7409	29.6072	29.5383	29.3969	
alpha	2.9399	2.9450	2.9500	2.9738	2.9738	2.9954	2.9913	2.9913	2.9827	2.9738	2.9692	2.9598	
util living area	0.9458	0.9225	0.8812	0.7996	0.6841	0.5112	0.3453	0.3570	0.5904	0.8083	0.9144	0.9525	(86)
MIT	19.2799	19.5139	19.9015	20.3593	20.7018	20.9138	20.9818	20.9801	20.8615	20.4465	19.8125	19.2390	(87)
Th 2	19.9213	19.9238	19.9263	19.9378	19.9378	19.9481	19.9461	19.9461	19.9421	19.9378	19.9356	19.9311	(88)
util rest of house	0.9366	0.9098	0.8613	0.7659	0.6289	0.4298	0.2428	0.2515	0.5098	0.7681	0.8979	0.9444	(89)
MIT 2	18.3864	18.6150	18.9908	19.4285	19.7317	19.9043	19.9413	19.9409	19.8655	19.5176	18.9189	18.3541	(90)
Living area fraction												fLA = Living area / (4) = 0.2769 (91)	
MIT	18.6337	18.8639	19.2430	19.6862	20.0003	20.1838	20.2294	20.2286	20.1413	19.7748	19.1663	18.5991	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4837	18.7139	19.0930	19.5362	19.8503	20.0338	20.0794	20.0786	19.9913	19.6248	19.0163	18.4491	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9211	0.8923	0.8430	0.7515	0.6239	0.4368	0.2561	0.2651	0.5138	0.7544	0.8804	0.9299	(94)
Ext temp.	741.6717	816.2166	838.0962	811.6190	678.1162	469.5716	263.1949	262.7564	491.9093	662.4565	706.4335	705.2713	(95)
Heat loss rate W	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000	(96)
Month fracti	1521.9274	1488.2322	1328.3334	1089.1274	797.6539	497.4155	266.7044	266.6151	539.2169	892.5535	1230.9063	1502.7249	(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	580.5102	451.5945	364.7365	199.8061	88.9360	0.0000	0.0000	0.0000	0.0000	171.1922	377.6204	593.3055	(98)
Space heating per m2												2827.7014 (98)	
												(98) / (4) = 30.6892 (99)	



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3124.5320 (211)
Space heating requirement	580.5102	451.5945	364.7365	199.8061	88.9360	0.0000	0.0000	0.0000	0.0000	171.1922	377.6204	593.3055	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	641.4478	498.9995	403.0237	220.7802	98.2719	0.0000	0.0000	0.0000	0.0000	189.1626	417.2601	655.5862	(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	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(64)
Efficiency of water heater (217)m	89.7437	89.6724	89.5092	89.1597	88.5474	87.3000	87.3000	87.3000	87.3000	89.0084	89.5421	89.7729	(217)
Fuel for water heating, kWh/month	193.1064	169.4803	176.2825	155.8030	151.6615	134.4355	126.2556	142.4925	143.4894	161.9890	173.8074	187.4522	(219)
Water heating fuel used													1916.2552 (219)
Annual totals kWh/year													
Space heating fuel - main system													3124.5320 (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)													398.6990 (232)
Total delivered energy for all uses													5514.4861 (238)

10a. Fuel costs - using BEDF prices (495)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3124.5320	3.6300	113.4205 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1916.2552	3.6300	69.5601 (247)
Pumps and fans for heating	75.0000	19.4400	14.5800 (249)
Energy for lighting	398.6990	19.4400	77.5071 (250)
Additional standing charges			95.0000 (251)
Total energy cost			370.0677 (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	3124.5320	0.2160	674.8989 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1916.2552	0.2160	413.9111 (264)
Space and water heating			1088.8100 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.6990	0.5190	206.9248 (268)
Total kg/year			1334.6598 (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	3124.5320	1.2200	3811.9290 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1916.2552	1.2200	2337.8313 (264)
Space and water heating			6149.7603 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	398.6990	3.0700	1224.0060 (268)
Primary energy kWh/year			7604.0163 (272)
Primary energy kWh/m2/year			82.5268 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84  
Current environmental impact rating: B 86

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

(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	Recommended
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	+ 1.2	-£ 26	-189 kg (14.2%)
U Solar photovoltaic panels	+ 9.7	-£ 363	-970 kg (84.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£26	2.05 kg/m <sup>2</sup>	B 85 B 88
Solar photovoltaic panels	£363	10.53 kg/m <sup>2</sup>	A 95 A 97
<b>Total Savings</b>	<b>£390</b>	<b>12.58 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 95  
 Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 495 TEST (29 Apr 2022)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, East Anglia):

	Current	Potential	Saving
Electricity	£92	£102	-£10
Mains gas	£278	£242	£36
Space heating	£223	£223	£0
Water heating	£70	£43	£26
Lighting	£78	£78	£0
Generated (PV)	-£0	-£363	£363
<b>Total cost of fuels</b>	<b>£370</b>	<b>-£19</b>	<b>£389</b>
<b>Total cost of uses</b>	<b>£371</b>	<b>-£19</b>	<b>£389</b>
Delivered energy	60 kWh/m <sup>2</sup>	29 kWh/m <sup>2</sup>	31 kWh/m <sup>2</sup>
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.2 tonnes
CO2 emissions per m <sup>2</sup>	14 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>	13 kg/m <sup>2</sup>
Primary energy	83 kWh/m <sup>2</sup>	9 kWh/m <sup>2</sup>	74 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				3 * 10 =	30.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				30.0000 / (5) =	0.1264 (8)							
Pressure test					Yes							
Measured/design AP50					5.0100							
Infiltration rate					0.3769 (18)							
Number of sides sheltered					1 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3487 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4446	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3923	0.4097 (22b)
Effective ac	0.5988	0.5950	0.5912	0.5736	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss						(33) + (36) =	64.1247 (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	46.8849	46.5844	46.2899	44.9068	44.6480	43.4433	43.4433	43.2202	43.9073	44.6480	45.1715	45.7188 (38)
Average = Sum(39)m / 12 =	111.0095	110.7091	110.4146	109.0314	108.7727	107.5680	107.5680	107.3449	108.0320	108.7727	109.2962	109.8435 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2048	1.2015	1.1983	1.1833	1.1805	1.1674	1.1674	1.1650	1.1725	1.1805	1.1862	1.1921 (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												2.6539 (42)
Average daily hot water use (litres/day)												97.2300 (43)
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy content (annual)												Total = Sum(45)m =	1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6927	13.2572	14.6428	14.1150	14.5452	14.0296	14.4683	14.5182	14.0761	14.6024	14.1826	14.6777	(61)
Total heat required for water heating calculated for each month	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(62)
Aperture area of solar collector													
Zero-loss collector efficiency													
Collector heat loss coefficient													
Collector 2nd order heat loss coefficient													
Collector effective heat loss coefficient													
Collector performance ratio													
Annual solar radiation per m2													
Overshading factor													
Solar energy available													
Adjustment factor for showers													
Solar-to-load ratio													
Utilisation factor													
Collector performance factor													
Dedicated solar storage volume													
Effective solar volume													
Daily hot water demand													
Volume ratio Veff/V													
Solar storage volume factor													
Solar input	-24.9814	-41.6867	-70.9973	-95.1504	-117.5503	-115.5706	-114.0433	-99.6402	-78.0383	-53.2910	-29.6315	-20.9051	(63)
Solar input (sum of months) = Sum(63)m =												-861.4861 (63)	
Output from w/h	148.3195	110.2902	86.7918	43.7631	16.7420	1.7915	0.0000	24.7558	47.2279	90.8928	125.9993	147.3761	(64)
Total per year (kWh/year) = Sum(64)m =												843.9501 (64)	
Heat gains from water heating, kWh/month	56.4104	49.4386	51.2568	45.0242	43.4522	37.8655	35.4549	40.1639	40.4897	46.7364	50.5772	54.7426	(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	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4400	50.1295	40.7680	30.8640	23.0712	19.4777	21.0463	27.3568	36.7183	46.6223	54.4151	58.0086	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	362.6271	366.3900	356.9075	336.7205	311.2379	287.2879	271.2879	267.5249	277.0074	297.1945	322.6770	346.6270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	75.8204	73.5694	68.8936	62.5337	58.4035	52.5909	47.6544	53.9838	56.2357	62.8177	70.2461	73.5788	(72)
Total internal gains	604.5426	599.7440	576.2243	539.7733	502.3678	469.0117	449.6437	458.5206	479.6165	516.2896	556.9933	587.8695	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
North	4.3260	10.6334	0.7600	0.7000	0.7700	16.9591 (74)							
East	1.7280	19.6403	0.7600	0.7000	0.7700	12.5123 (76)							
South	8.7600	46.7521	0.7600	0.7000	0.7700	150.9906 (78)							
Solar gains	180.4619	304.1700	410.3771	503.2622	562.1996	558.3476	538.1535	493.5744	442.1461	334.3417	215.4979	154.8972	(83)
Total gains	785.0045	903.9140	986.6014	1043.0354	1064.5673	1027.3593	987.7973	952.0951	921.7626	850.6313	772.4911	742.7667	(84)

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

Temperature during heating periods in the living area from Table 9, T <sub>hl</sub> (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	28.9431	29.0217	29.0991	29.4682	29.5383	29.8692	29.8692	29.9312	29.7409	29.5383	29.3969	29.2504	
alpha	2.9295	2.9348	2.9399	2.9645	2.9692	2.9913	2.9913	2.9954	2.9827	2.9692	2.9598	2.9500	
util living area	0.9518	0.9278	0.8914	0.8278	0.7287	0.5864	0.4500	0.4810	0.6648	0.8430	0.9287	0.9581	(86)
MIT	19.1700	19.4379	19.8046	20.2414	20.6071	20.8562	20.9518	20.9400	20.7786	20.3101	19.6668	19.1182	(87)
Th 2	19.9162	19.9188	19.9213	19.9334	19.9356	19.9461	19.9461	19.9481	19.9421	19.9356	19.9311	19.9263	(88)
util rest of house	0.9438	0.9161	0.8735	0.7984	0.6804	0.5116	0.3529	0.3842	0.5951	0.8100	0.9151	0.9510	(89)
MIT 2	18.2747	18.5372	18.8939	19.3172	19.6499	19.8633	19.9271	19.9229	19.8042	19.3919	18.7747	18.2315	(90)
Living area fraction													
MIT	18.5226	18.7866	19.1460	19.5731	19.9150	20.1382	20.2108	20.2045	20.0740	19.6461	19.0217	18.4770	(92)
Temperature adjustment													
adjusted MIT	18.3726	18.6366	18.9960	19.4231	19.7650	19.9882	20.0608	20.0545	19.9240	19.4961	18.8717	18.3270	(93)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9290	0.8988	0.8550	0.7822	0.6718	0.5148	0.3639	0.3945	0.5938	0.7941	0.8982	0.9373	(94)
Useful gains	729.2577	812.4570	843.5718	815.8770	715.1838	528.8477	359.4901	375.6057	547.3664	675.4441	693.8643	696.1685	(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	1562.1895	1520.7676	1379.7430	1147.3469	877.2468	579.6021	372.2735	392.2879	629.1778	967.6555	1286.5978	1551.7597	(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	619.7013	475.9847	398.9114	238.6584	120.5749	0.0000	0.0000	0.0000	0.0000	217.4053	426.7681	636.5598	(98)
Space heating												3134.5638	(98)
Space heating per m2												(98) / (4) =	34.0196 (99)

#### 8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3463.6064 (211)
Space heating requirement	619.7013	475.9847	398.9114	238.6584	120.5749	0.0000	0.0000	0.0000	0.0000	217.4053	426.7681	636.5598	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	684.7528	525.9499	440.7860	263.7109	133.2319	0.0000	0.0000	0.0000	0.0000	240.2268	471.5670	703.3810	(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	148.3195	110.2902	86.7918	43.7631	16.7420	1.7915	0.0000	24.7558	47.2279	90.8928	125.9993	147.3761	(64)
Efficiency of water heater (217)m	89.8639	89.8802	89.9111	89.9889	90.0973	87.3000	87.3000	87.3000	87.3000	89.5324	89.7501	89.8806	(216)
Fuel for water heating, kWh/month	165.0491	122.7080	96.5307	48.6317	18.5822	2.0522	0.0000	28.3571	54.0985	101.5194	140.3890	163.9687	(219)
Water heating fuel used												941.8864	(219)
Annual totals kWh/year													
Space heating fuel - main system													3463.6064 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													398.6990 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394			-1727.2394 (233)
Total delivered energy for all uses													3201.9524 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3463.6064	3.4800	120.5335	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	941.8864	3.4800	32.7776	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	398.6990	13.1900	52.5884	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit		-1727.2394	13.1900	-227.8229 (252)
Total energy cost			114.5642	(255)

#### 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)		0.3509 (257)
SAP value	[(255) x (256)] / [(4) + 45.0] =	95.1055
SAP rating (Section 12)		95 (258)
SAP band		A

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3463.6064	0.2160	748.1390 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	941.8864	0.2160	203.4475 (264)
Space and water heating			951.5864 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	398.6990	0.5190	206.9248 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			326.9490 (272)
CO2 emissions per m2			3.5500 (273)
EI value			96.8054
EI rating			97 (274)
EI band			A

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# 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	46.0700 (1b)	2.4600 (2b)	113.3322 (1b) - (3b)
First floor	46.0700 (1c)	2.6900 (2c)	123.9283 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.1400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 237.2605 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				3 * 10 =	30.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1264 (8)							
Pressure test					Yes							
Measured/design AP50					5.0100							
Infiltration rate					0.3769 (18)							
Number of sides sheltered					1 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3487 (21)							
Wind speed	Jan 4.9000	Feb 4.8000	Mar 4.7000	Apr 4.2000	May 4.2000	Jun 3.7000	Jul 3.8000	Aug 3.8000	Sep 4.0000	Oct 4.2000	Nov 4.3000	Dec 4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infilt rate												
Effective ac	0.4271	0.4184	0.4097	0.3661	0.3661	0.3225	0.3312	0.3312	0.3487	0.3661	0.3748	0.3923 (22b)
	0.5912	0.5875	0.5839	0.5670	0.5670	0.5520	0.5549	0.5549	0.5608	0.5670	0.5702	0.5769 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 1.20)			14.8100	1.1450	16.9695		(27)
Solid Door			2.1500	1.3000	2.7950		(26)
Flr - Ground			46.0700	0.1500	6.9105	75.6000	3482.8920 (28a)
Wl - Brick	96.8040	16.9620	79.8420	0.2400	19.1621	38.9400	3109.0475 (29a)
Wl - Clad	1.9960		1.9960	0.2400	0.4790	38.9400	77.7242 (29a)
Rf - Ins Joist	46.0660		46.0660	0.1100	5.0673	5.8200	268.1041 (30)
Total net area of external elements Aum(A, m2)			190.9440				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.3833		(33)
Party Wall			46.8880	0.0000	0.0000	54.0300	2533.3586 (32)
Ground Floor Stud			67.1099			5.8200	390.5795 (32c)
1st Floor Stud			104.4358			5.8200	607.8161 (32c)
Internal Floor			46.0600			18.0000	829.0800 (32d)
Internal Ceiling			46.0600			5.8200	268.0692 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11566.6713 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.5337 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7413 (36)
Total fabric heat loss							(33) + (36) = 64.1247 (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	46.2899	46.0014	45.7188	44.3951	44.3951	43.2202	43.4433	43.4433	43.9073	44.3951	44.6480	45.1715 (38)
Average = Sum(39)m / 12 =	110.4146	110.1261	109.8435	108.5198	108.5198	107.3449	107.5680	107.5680	108.0320	108.5198	108.7727	109.2962 (39)
HLP	1.1983	1.1952	1.1921	1.1778	1.1778	1.1650	1.1674	1.1674	1.1725	1.1778	1.1805	1.1862 (40)
HLP (average)												1.1798 (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												2.6539 (42)
Average daily hot water use (litres/day)												97.2300 (43)
Daily hot water use	106.9530	103.0638	99.1746	95.2854	91.3962	87.5070	87.5070	91.3962	95.2854	99.1746	103.0638	106.9530 (44)
Energy conte	158.6082	138.7197	143.1463	124.7984	119.7471	103.3326	95.7528	109.8778	111.1901	129.5813	141.4481	153.6035 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy content (annual)												Total = Sum(45)m =	1529.8059 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.7912	20.8080	21.4719	18.7198	17.9621	15.4999	14.3629	16.4817	16.6785	19.4372	21.2172	23.0405	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6927	13.2572	14.6428	14.1150	14.5452	14.0296	14.4683	14.5182	14.0761	14.6024	14.1826	14.6777	(61)
Total heat required for water heating calculated for each month	173.3009	151.9769	157.7891	138.9135	134.2923	117.3622	110.2211	124.3960	125.2662	144.1838	155.6308	168.2812	(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												1168.2835 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												1962.7164 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.2830 (H8)	
Utilisation factor												0.5413 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												97.2300 (H14)	
Volume ratio Veff/V												0.7714 (H15)	
Solar storage volume factor												0.9481 (H16)	
Solar input												-885.7324 (H17)	
Solar input	-26.8067	-41.7048	-69.8050	-98.2418	-117.0565	-119.9144	-117.1719	-103.2119	-81.3126	-55.7149	-32.5796	-22.2122	(63)
												Solar input (sum of months) = Sum(63)m =	-885.7324 (63)
Output from w/h	146.4942	110.2721	87.9841	40.6717	17.2358	0.0000	0.0000	21.1841	43.9536	88.4688	123.0512	146.0691	(64)
												Total per year (kWh/year) = Sum(64)m =	825.3846 (64)
Heat gains from water heating, kWh/month	56.4104	49.4386	51.2568	45.0242	43.4522	37.8655	35.4549	40.1639	40.4897	46.7364	50.5772	54.7426	(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	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	159.2336	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4400	50.1295	40.7680	30.8640	23.0712	19.4777	21.0463	27.3568	36.7183	46.6223	54.4151	58.0086	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	362.6271	366.3900	356.9075	336.7205	311.2379	287.2879	271.2879	267.5249	277.0074	297.1945	322.6770	346.6270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	53.5773	(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)	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	-106.1557	(71)
Water heating gains (Table 5)	75.8204	73.5694	68.8936	62.5337	58.4035	52.5909	47.6544	53.9838	56.2357	62.8177	70.2461	73.5788	(72)
Total internal gains	604.5426	599.7440	576.2243	539.7733	502.3678	469.0117	449.6437	458.5206	479.6165	516.2896	556.9933	587.8695	(73)

#### 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North		4.3260	12.0539	0.7600	0.7000	0.7700	19.2247 (74)						
East		1.7280	22.4175	0.7600	0.7000	0.7700	14.2815 (76)						
South		8.7600	51.7504	0.7600	0.7000	0.7700	167.1332 (78)						
Solar gains	200.6394	314.9837	417.9265	540.2450	584.5465	606.1126	577.9755	532.5197	477.7468	361.7929	245.4010	170.5971	(83)
Total gains	805.1820	914.7277	994.1507	1080.0183	1086.9143	1075.1242	1027.6193	991.0403	957.3634	878.0825	802.3943	758.4666	(84)

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

Temperature during heating periods in the living area from Table 9, T <sub>hl</sub> (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.0991	29.1753	29.2504	29.6072	29.6072	29.9312	29.8692	29.8692	29.7409	29.6072	29.5383	29.3969	
alpha	2.9399	2.9450	2.9500	2.9738	2.9738	2.9954	2.9913	2.9913	2.9827	2.9738	2.9692	2.9598	
util living area	0.9458	0.9225	0.8812	0.7996	0.6841	0.5112	0.3453	0.3570	0.5904	0.8083	0.9144	0.9525	(86)
MIT	19.2799	19.5139	19.9015	20.3593	20.7018	20.9138	20.9818	20.9801	20.8615	20.4465	19.8125	19.2390	(87)
Th 2	19.9213	19.9238	19.9263	19.9378	19.9378	19.9481	19.9461	19.9461	19.9421	19.9378	19.9356	19.9311	(88)
util rest of house	0.9366	0.9098	0.8613	0.7659	0.6289	0.4298	0.2428	0.2515	0.5098	0.7681	0.8979	0.9444	(89)
MIT 2	18.3864	18.6150	18.9908	19.4285	19.7317	19.9043	19.9413	19.9409	19.8655	19.5176	18.9189	18.3541	(90)
Living area fraction												fLA = Living area / (4) =	
MIT	18.6337	18.8639	19.2430	19.6862	20.0003	20.1838	20.2294	20.2286	20.1413	19.7748	19.1663	18.5991	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4837	18.7139	19.0930	19.5362	19.8503	20.0338	20.0794	20.0786	19.9913	19.6248	19.0163	18.4491	(93)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9211	0.8923	0.8430	0.7515	0.6239	0.4368	0.2561	0.2651	0.5138	0.7544	0.8804	0.9299	(94)
Useful gains	741.6717	816.2166	838.0962	811.6190	678.1162	469.5716	263.1949	262.7564	491.9093	662.4565	706.4335	705.2713	(95)
Ext temp.	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000	(96)
Heat loss rate W	1521.9274	1488.2322	1328.3334	1089.1274	797.6539	497.4155	266.7044	266.6151	539.2169	892.5535	1230.9063	1502.7249	(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	580.5102	451.5945	364.7365	199.8061	88.9360	0.0000	0.0000	0.0000	0.0000	171.1922	377.6204	593.3055	(98)
Space heating													
Space heating per m2													(98) / (4) = 30.6892 (99)

#### 8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3124.5320 (211)
Space heating requirement	580.5102	451.5945	364.7365	199.8061	88.9360	0.0000	0.0000	0.0000	0.0000	171.1922	377.6204	593.3055	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	641.4478	498.9995	403.0237	220.7802	98.2719	0.0000	0.0000	0.0000	0.0000	189.1626	417.2601	655.5862	(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	146.4942	110.2721	87.9841	40.6717	17.2358	0.0000	0.0000	21.1841	43.9536	88.4688	123.0512	146.0691	(64)
Efficiency of water heater (217)m	89.8365	89.8536	89.8599	89.9424	89.9647	87.3000	87.3000	87.3000	87.3000	89.3837	89.6920	89.8494	(216)
Fuel for water heating, kWh/month	163.0677	122.7242	97.9126	45.2197	19.1584	0.0000	0.0000	24.2658	50.3477	98.9764	137.1931	162.5711	(219)
Water heating fuel used													921.4368 (219)
Annual totals kWh/year													
Space heating fuel - main system													3124.5320 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													398.6990 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1168 * 0.80) =									-1869.2537				-1869.2537 (233)
Total delivered energy for all uses													2700.4141 (238)

#### 10a. Fuel costs - using BEDF prices (495)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3124.5320	3.6300	113.4205 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	921.4368	3.6300	33.4482 (247)	
Pumps and fans for heating	75.0000	19.4400	14.5800 (249)	
Pump for solar water heating	50.0000	19.4400	9.7200 (249)	
Energy for lighting	398.6990	19.4400	77.5071 (250)	
Additional standing charges			95.0000 (251)	
Energy saving/generation technologies				
PV Unit	-1869.2537	19.4400	-363.3829 (252)	
Total energy cost			-19.7072 (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	3124.5320	0.2160	674.8989 (261)	
Space heating - secondary	0.0000	0.0000	0.0000 (263)	
Water heating (other fuel)	921.4368	0.2160	199.0303 (264)	
Space and water heating			873.9292 (265)	
Pumps and fans	125.0000	0.5190	64.8750 (267)	
Energy for lighting	398.6990	0.5190	206.9248 (268)	
Energy saving/generation technologies				
PV Unit	-1869.2537	0.5190	-970.1427 (269)	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Total kg/year 175.5864 (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	3124.5320	1.2200	3811.9290 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	921.4368	1.2200	1124.1528 (264)
Space and water heating			4936.0819 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	398.6990	3.0700	1224.0060 (268)
Energy saving/generation technologies			
PV Unit	-1869.2537	3.0700	-5738.6088 (269)
Primary energy kWh/year			805.2290 (272)
Primary energy kWh/m2/year			8.7392 (273)

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

#### Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	East Anglia
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	125.5 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.55 (Calculated rate)

#### Overheating Calculation

Summer ventilation heat loss coefficient	356.31 (P1)
Transmission heat loss coefficient	64.12 (37)
Summer heat loss coefficient	420.43 (P2)

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

Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	0.850	0.90	1.000	0.765 (P8)
East	0.850	0.90	1.000	0.765 (P8)
South	0.850	0.90	1.000	0.765 (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	4.3260	82.1233	0.7600	0.7000	0.7650	130.1273
East	1.7280	119.4717	0.7600	0.7000	0.7650	75.6179
South	8.7600	114.8394	0.7600	0.7000	0.7650	368.4773

total: 574.2224

Solar gains	Jun 602	Jul 574	Aug 529	(P3/P4)
Internal gains	466	447	456	
Total summer gains	1068	1021	985	(P5)

Summer gain/loss ratio	2.54	2.43	2.34	(P6)
Summer external temperature	15.40	17.60	17.60	
Thermal mass temperature increment (TMP = 125.5)	1.12	1.12	1.12	
Threshold temperature	19.06	21.15	21.06	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

<b>Property Reference</b>	011 - PRJ012706		<b>Issued on Date</b>	27/03/2023	
<b>Assessment Reference</b>	011 S	<b>Prop Type Ref</b>	C		
<b>Property</b>	011 - PRJ012706				
<b>SAP Rating</b>	84 B	<b>DER</b>	16.75	<b>TER</b>	17.44
<b>Environmental</b>	86 B	<b>% DER&lt;TER</b>	3.95		
<b>CO<sub>2</sub> Emissions (t/year)</b>	1.33	<b>DFEE</b>	44.34	<b>TFEE</b>	50.16
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	11.59		
<b>Assessor Details</b>	Chris Nicholls, , Tel: ,		<b>Assessor ID</b>	U903-0001	
<b>Client</b>					

### SUMMARY FOR INPUT DATA FOR New Build (As Designed)

#### Criterion 1 – Achieving the TER and TFEE rate

##### 1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.44	kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling Carbon Dioxide Emission Rate (DER)	16.75	kgCO <sub>2</sub> /m <sup>2</sup>	Pass
	-0.69 (-4.0%)	kgCO <sub>2</sub> /m <sup>2</sup>	

##### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	50.16	kWh/m <sup>2</sup> /yr	
Dwelling Fabric Energy Efficiency (DFEE)	44.34	kWh/m <sup>2</sup> /yr	
	-5.9 (-11.8%)	kWh/m <sup>2</sup> /yr	Pass

#### Criterion 2 – Limits on design flexibility

##### Limiting Fabric Standards

##### 2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	Pass
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	Pass
Openings	1.21 (max. 2.00)	1.30 (max. 3.30)	Pass

##### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

##### 3 Air permeability

Air permeability at 50 pascals	5.01 (design value)	
Maximum	10.0	Pass

##### Limiting System Efficiencies

##### 4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Ideal LOGIC COMBI ESP1 30 Combi boiler Efficiency: 89.6% SEDBUK2009 Minimum: 88.0%	Pass
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# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

Secondary heating system

None

### 5 Cylinder insulation

Hot water storage

No cylinder

### 6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

### 7 Low energy lights

Percentage of fixed lights with low-energy fittings

100

%

Minimum

75

%

Pass

### 8 Mechanical ventilation

Not applicable

## Criterion 3 – Limiting the effects of heat gains in summer

### 9 Summertime temperature

Overheating risk (East Anglia)

Slight

Pass

Based on:

Overshading

Average

Windows facing North

4.33 m<sup>2</sup>, No overhang

Windows facing East

1.73 m<sup>2</sup>, No overhang

Windows facing South

8.76 m<sup>2</sup>, No overhang

Air change rate

4.55 ach

Blinds/curtains

Dark-coloured curtain or roller blind, closed 100% of daylight hours

## Criterion 4 – Building performance consistent with DER and DFEE rate

### Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m<sup>2</sup>K

Pass

### Air permeability and pressure testing

#### 3 Air permeability

Air permeability at 50 pascals

5.01 (design value)

Maximum

10.0

Pass

### 10 Key features

Party wall U-value

0.00

W/m<sup>2</sup>K

Roof U-value

0.11

W/m<sup>2</sup>K