

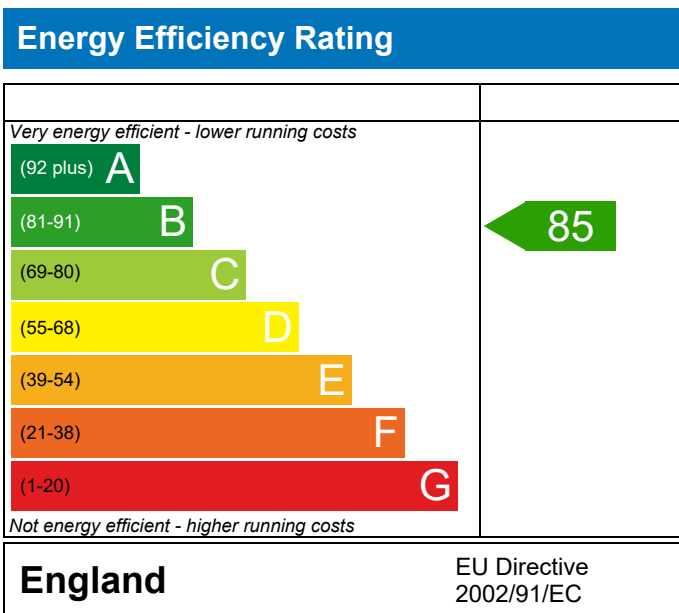
# PREDICTED ENERGY ASSESSMENT

Lancing Phase 2,  
BN15

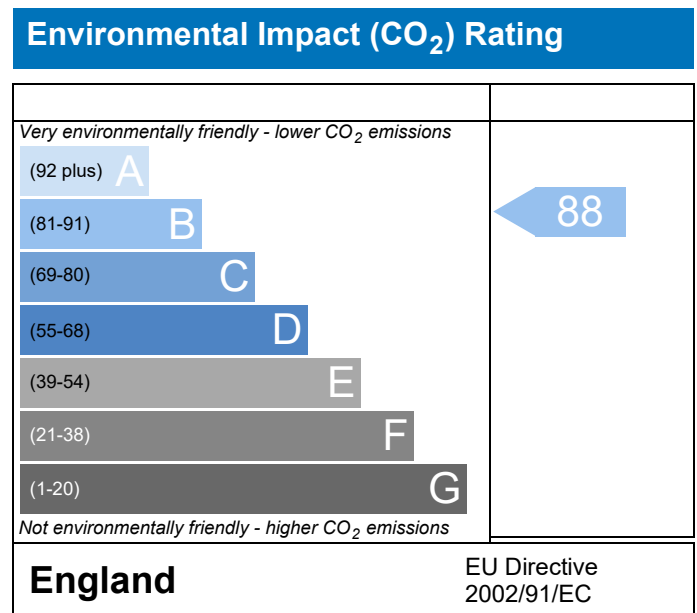
Dwelling type: House, Mid-Terrace  
Date of assessment: 01/02/2023  
Produced by: Michael Juckes  
Total floor area: 94.29 m<sup>2</sup>

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	629 - PRJ012992			Issued on Date	01/02/2023
Assessment Reference	629	Prop Type Ref	Clover		
Property	Lancing Phase 2, BN15				
SAP Rating	85 B	DER	14.89	TER	16.06
Environmental	88 B	% DER<TER	7.29		
CO <sub>2</sub> Emissions (t/year)	1.19	DFEE	36.74	TFEE	42.85
General Requirements Compliance	Pass	% DFEE<TFEE	14.26		
Assessor Details	Chris Nicholls, , Tel: ,			Assessor ID	T850-0001
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

Mid-Terrace House, total floor area 94 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) 16.06 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.89 kgCO<sub>2</sub>/m<sup>2</sup>OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)42.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)36.7 kWh/m<sup>2</sup>/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.35 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (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 (South East England): Slight OK

Based on:

Overshading:

Average

Windows facing North:

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

Windows facing South:

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

Air change rate:

4.61 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 0.10 W/m<sup>2</sup>K

Door U-value 1.09 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	47.1450 (1b)	x 2.3850 (2b)	= 112.4408 (1b) - (3b)
First floor	47.1450 (1c)	x 2.6860 (2c)	= 126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 239.0723 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				2 * 10 =	20.0000 (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) =				20.0000 / (5) =	0.0837 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3337 (18)							
Number of sides sheltered					2 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2836 (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	0.3616	0.3545	0.3474	0.3120	0.3049	0.2694	0.2694	0.2623	0.2836	0.3049	0.3191	0.3332 (22b)
Effective ac	0.5654	0.5628	0.5604	0.5487	0.5465	0.5363	0.5363	0.5344	0.5402	0.5465	0.5509	0.5555 (25)

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

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss			(33) + (36) =				49.7935 (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	44.6048	44.4045	44.2082	43.2861	43.1136	42.3104	42.3104	42.1617	42.6198	43.1136	43.4626	43.8275 (38)
Average = Sum(39)m / 12 =	94.3983	94.1980	94.0017	93.0795	92.9070	92.1039	92.1039	91.9552	92.4132	92.9070	93.2560	93.6209 (39)
HLP	1.0011	0.9990	0.9969	0.9872	0.9853	0.9768	0.9768	0.9752	0.9801	0.9853	0.9890	0.9929 (40)
HLP (average)												0.9872 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (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 =	1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m														
	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875	23.1875	(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	14.6958	13.2599	14.6483	14.1196	14.5494	14.0330	14.4715	14.5220	14.0802	14.6074	14.1854	14.6807	14.6807	(61)
Total heat required for water heating calculated for each month	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641	(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	(63)
													Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641	(64)
													Total per year (kWh/year) = Sum(64)m =	1711.4180 (64)
Heat gains from water heating, kWh/month	56.7476	49.7335	51.5618	45.2901	43.7073	38.0855	35.6588	40.3979	40.7266	47.0125	50.8779	55.0691	55.0691	(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	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.8241	21.1604	17.2088	13.0281	9.7387	8.2218	8.8840	11.5477	15.4993	19.6799	22.9694	24.4863	24.4863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7528	249.3133	242.8608	229.1244	211.7846	195.4876	184.6002	182.0397	188.4921	202.2286	219.5684	235.8654	235.8654	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	(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	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)
Water heating gains (Table 5)	76.2736	74.0082	69.3035	62.9029	58.7463	52.8966	47.9285	54.2983	56.5647	63.1888	70.6637	74.0177	74.0177	(72)
Total internal gains	413.0506	410.6820	395.5733	371.2556	346.4697	322.8061	307.6128	314.0858	326.7563	351.2975	379.4016	400.5694	400.5694	(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		5.5160	10.6334	0.7300	0.7200	0.7700	21.3641 (74)							
South		6.7760	46.7521	0.7300	0.7200	0.7700	115.3886 (78)							
Solar gains	136.7527	229.8046	310.0994	383.5056	433.6281	433.5453	416.6204	377.9247	334.8766	252.4294	163.1302	117.5165	117.5165	(83)
Total gains	549.8033	640.4866	705.6727	754.7612	780.0978	756.3514	724.2331	692.0105	661.6328	603.7269	542.5318	518.0859	518.0859	(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	25.8614	25.9163	25.9705	26.2278	26.2765	26.5056	26.5056	26.5485	26.4169	26.2765	26.1781	26.0761	26.0761	
alpha	2.7241	2.7278	2.7314	2.7485	2.7518	2.7670	2.7670	2.7699	2.7611	2.7518	2.7452	2.7384	2.7384	
util living area	0.9623	0.9427	0.9126	0.8587	0.7697	0.6377	0.5039	0.5392	0.7204	0.8759	0.9447	0.9674	0.9674	(86)
MIT	18.8134	19.0927	19.4965	19.9964	20.4464	20.7742	20.9150	20.8949	20.6612	20.0812	19.3561	18.7557	18.7557	(87)
Th 2	20.0824	20.0841	20.0859	20.0940	20.0956	20.1027	20.1027	20.1040	20.1000	20.0956	20.0925	20.0893	20.0893	(88)
util rest of house	0.9572	0.9350	0.9006	0.8380	0.7334	0.5763	0.4178	0.4545	0.6664	0.8536	0.9360	0.9630	0.9630	(89)
MIT 2	18.0707	18.3469	18.7443	19.2347	19.6590	19.9532	20.0605	20.0490	19.8609	19.3249	18.6163	18.0187	18.0187	(90)
Living area fraction													fLA = Living area / (4) =	0.2008 (91)
MIT	18.2198	18.4967	18.8953	19.3876	19.8171	20.1181	20.2320	20.2189	20.0216	19.4768	18.7648	18.1667	18.1667	(92)
Temperature adjustment													-0.1500	
adjusted MIT	18.0698	18.3467	18.7453	19.2376	19.6671	19.9681	20.0820	20.0689	19.8716	19.3268	18.6148	18.0167	18.0167	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.9423	0.9165	0.8788	0.8149	0.7139	0.5662	0.4157	0.4509	0.6509	0.8305	0.9177	0.9494	0.9494	(94)
Useful gains	518.0753	586.9894	620.1425	615.0637	556.9280	428.2793	301.0349	312.0474	430.6827	501.3851	497.8737	491.8776	491.8776	(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	4.2000	(96)
Heat loss rate W	1299.8477	1266.6482	1151.0814	962.2194	740.1952	494.4203	320.7087	337.3702	533.3732	810.7796	1073.8257	1293.5285	1293.5285	(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	1.0000	(97a)
Space heating kWh	581.6387	456.7307	395.0186	249.9521	136.3508	0.0000	0.0000	0.0000	0.0000	230.1895	414.6854	596.4283	596.4283	(98)
Space heating													3060.9941 (98)	
Space heating per m <sup>2</sup>													(98) / (4) =	32.4636 (99)

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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													3382.3140 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	581.6387	456.7307	395.0186	249.9521	136.3508	0.0000	0.0000	0.0000	0.0000	230.1895	414.6854	596.4283	(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)	642.6947	504.6748	436.4846	276.1902	150.6639	0.0000	0.0000	0.0000	0.0000	254.3531	458.2160	659.0368	(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	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	(64)
Efficiency of water heater (217)m	89.7415	89.6757	89.5591	89.3260	88.8788	87.3000	87.3000	87.3000	87.3000	89.2358	89.6000	87.3000	(216)
Fuel for water heating, kWh/month	194.2421	170.4637	177.2101	156.4092	151.9602	135.1945	126.9590	143.2998	144.3065	162.5080	174.7052	188.5476	(219)
Water heating fuel used													1925.8060 (219)
Annual totals kWh/year													
Space heating fuel - main system													3382.3140 (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)													420.7414 (232)
Total delivered energy for all uses													5803.8613 (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	3382.3140	0.2160	730.5798 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1925.8060	0.2160	415.9741 (264)
Space and water heating			1146.5539 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	420.7414	0.5190	218.3648 (268)
Total CO2, kg/year			1403.8437 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.8900 (273)

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

	TFA	N	EF
DER			14.8900 ZC1
Total Floor Area	94.2900		
Assumed number of occupants	2.6800		
CO2 emission factor in Table 12 for electricity displaced from grid		0.5190	
CO2 emissions from appliances, equation (L14)			15.5075 ZC2
CO2 emissions from cooking, equation (L16)			1.9442 ZC3
Total CO2 emissions			32.3417 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			32.3417 ZC8

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(3a) + (3b) + (3c) + (3d) + (3e)...(3n) = 239.0723 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				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) =	0.1255 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3755 (18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3192 (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	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750 (22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703 (25)

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

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1300	6.1289		(28a)
Brick	44.2450	11.5330	32.7120	0.1800	5.8882		(29a)
Render	11.3530	2.8800	8.4730	0.1800	1.5251		(29a)
Rf - Ins Joist	47.1450		47.1450	0.1300	6.1289		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =		38.0978 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0304 (36)
Total fabric heat loss						(33) + (36) =	47.1282 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	45.9791	45.7254	45.4768	44.3090	44.0905	43.0734	43.0734	42.8850	43.4652	44.0905	44.5325	44.9946 (38)
Heat transfer coeff	93.1073	92.8537	92.6050	91.4372	91.2188	90.2016	90.2016	90.0133	90.5934	91.2188	91.6608	92.1229 (39)
Average = Sum(39)m / 12 =												91.4362 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9875	0.9848	0.9821	0.9697	0.9674	0.9566	0.9566	0.9546	0.9608	0.9674	0.9721	0.9770 (40)
HLP (average)												0.9697 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (45)
Energy content (annual)												Total = Sum(45)m = 1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.8607	47.2898	46.8716	43.4294	44.8771	46.8716	47.2898	50.8607	49.3151	50.9589	61									
Total heat required for water heating calculated for each month	210.5788	185.6320	194.9201	172.8843	167.3825	147.4212	141.2407	157.4503	159.1892	181.2686	191.6655	205.5423	(62)									
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)									
Output from w/h	210.5788	185.6320	194.9201	172.8843	167.3825	147.4212	141.2407	157.4503	159.1892	181.2686	191.6655	205.5423	(64)									
Heat gains from water heating, kWh/month	65.8134	57.9254	60.6149	53.5826	51.7878	45.4346	43.2602	48.4853	49.0290	56.0758	59.6603	64.1387	(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	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.9728	21.2925	17.3162	13.1095	9.7995	8.2731	8.9394	11.6198	15.5961	19.8028	23.1128	24.6391	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7528	249.3133	242.8608	229.1244	211.7846	195.4876	184.6002	182.0397	188.4921	202.2286	219.5684	235.8654	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	(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)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)
Water heating gains (Table 5)	88.4588	86.1985	81.4717	74.4203	69.6072	63.1036	58.1454	65.1684	68.0958	75.3707	82.8615	86.2079	(72)
Total internal gains	425.3845	423.0044	407.8489	382.8543	357.3914	333.0645	317.8852	325.0280	338.3841	363.6022	391.7428	412.9126	(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	5.5160	10.6334	0.6300	0.7000	0.7700	17.9254	(74)						
South	6.7760	46.7521	0.6300	0.7000	0.7700	96.8158	(78)						
Solar gains	114.7411	192.8155	260.1862	321.7770	363.8318	363.7624	349.5616	317.0943	280.9752	211.7987	136.8729	98.6012	(83)
Total gains	540.1256	615.8199	668.0350	704.6313	721.2232	696.8268	667.4468	642.1224	619.3593	575.4009	528.6157	511.5137	(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)	0.9984	0.9962	0.9906	0.9718	0.9123	0.7630	0.5827	0.6263	0.8572	0.9774	0.9963	0.9988	(86)
MIT	19.9575	20.0948	20.3003	20.5658	20.8038	20.9529	20.9918	20.9877	20.9029	20.6020	20.2306	19.9338	(87)
Th 2	20.0938	20.0960	20.0983	20.1086	20.1106	20.1196	20.1196	20.1213	20.1161	20.1106	20.1066	20.1025	(88)
util rest of house	0.9979	0.9950	0.9873	0.9610	0.8776	0.6827	0.4724	0.5160	0.7937	0.9666	0.9948	0.9984	(89)
MIT 2	18.6934	18.8954	19.1957	19.5841	19.9080	20.0861	20.1163	20.1159	20.0354	19.6408	19.1021	18.6651	(90)
Living area fraction	18.9472	19.1362	19.4175	19.7812	20.0879	20.2601	20.2921	20.2909	20.2096	19.8338	19.3286	18.9198	(92)
Temperature adjustment	18.9472	19.1362	19.4175	19.7812	20.0879	20.2601	20.2921	20.2909	20.2096	19.8338	19.3286	18.9198	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	538.4420	611.5699	657.2488	673.5874	632.2212	485.3553	330.1284	345.5677	496.3410	553.6534	524.9190	510.3279	(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	1363.7601	1321.8817	1196.2265	994.9483	765.1306	510.5520	333.0324	350.2329	553.4865	842.2914	1120.8866	1356.0330	(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	614.0367	477.3295	400.9994	231.3798	98.8846	0.0000	0.0000	0.0000	0.0000	214.7466	429.0967	629.2046	(98)
Space heating												3095.6778	(98)
Space heating per m2												32.8315	(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

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													3314.4302 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	614.0367	477.3295	400.9994	231.3798	98.8846	0.0000	0.0000	0.0000	0.0000	214.7466	429.0967	629.2046	(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)	657.4268	511.0594	429.3355	247.7300	105.8721	0.0000	0.0000	0.0000	0.0000	229.9214	459.4183	673.6666	(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	210.5788	185.6320	194.9201	172.8843	167.3825	147.4212	141.2407	157.4503	159.1892	181.2686	191.6655	205.5423	(64)
Efficiency of water heater (217)m	87.5868	87.3246	86.8278	85.7856	83.7760	80.3000	80.3000	80.3000	80.3000	85.4788	87.0205	80.3000	(216)
Fuel for water heating, kWh/month	240.4232	212.5771	224.4904	201.5306	199.7976	183.5880	175.8913	196.0776	198.2431	212.0628	220.2532	234.4116	(219)
Water heating fuel used													2499.3466 (219)
Annual totals kWh/year													
Space heating fuel - main system													3314.4302 (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)													423.3678 (232)
Total delivered energy for all uses													6312.1446 (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	3314.4302	0.2160	715.9169 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2499.3466	0.2160	539.8589 (264)
Space and water heating			1255.7758 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	423.3678	0.5190	219.7279 (268)
Total CO2, kg/m2/year			1514.4287 (272)
Emissions per m2 for space and water heating			13.3182 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3303 (272b)
Emissions per m2 for pumps and fans			0.4128 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.3182 * 1.00) + 2.3303 + 0.4128, rounded to 2 d.p.			16.0600 (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	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (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) =	0.1255 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3755 (18)							
Number of sides sheltered					2 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3192 (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	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750 (22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Fir - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m2)			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss							(33) + (36) = 49.7935 (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	45.9791	45.7254	45.4768	44.3090	44.0905	43.0734	43.0734	42.8850	43.4652	44.0905	44.5325	44.9946 (38)
Average = Sum(39)m / 12 =	95.7725	95.5189	95.2703	94.1025	93.8840	92.8669	92.8669	92.6785	93.2586	93.8840	94.3260	94.7881 (39)
HLP	1.0157	1.0130	1.0104	0.9980	0.9957	0.9849	0.9849	0.9829	0.9891	0.9957	1.0004	1.0053 (40)
HLP (average)												0.9980 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (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 =	1539.5649 (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	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	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	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	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	33.9192	29.6660	30.6126	26.6888	25.6086	22.0983	20.4773	23.4980	23.7786	27.7117	30.2495	32.8490	65)					

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

Metabolic gains (Table 5), Watts																		
(66)m	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.8241	21.1604	17.2088	13.0281	9.7387	8.2218	8.8840	11.5477	15.4993	19.6799	22.9694	24.4863	(67)					
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7528	249.3133	242.8608	229.1244	211.7846	195.4876	184.6002	182.0397	188.4921	202.2286	219.5684	235.8654	(68)					
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	(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)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)					
Water heating gains (Table 5)	45.5904	44.1458	41.1460	37.0678	34.4201	30.6920	27.5232	31.5833	33.0259	37.2469	42.0132	44.1518	(72)					
Total internal gains	379.3674	377.8196	364.4158	342.4205	319.1435	297.6015	284.2075	288.3708	300.2174	322.3555	347.7511	367.7036	(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	5.5160	10.6334	0.7300	0.7200	0.7700	21.3641 (74)							
South	6.7760	46.7521	0.7300	0.7200	0.7700	115.3886 (78)							
Solar gains	136.7527	229.8046	310.0994	383.5056	433.6281	433.5453	416.6204	377.9247	334.8766	252.4294	163.1302	117.5165	(83)
Total gains	516.1201	607.6242	674.5152	725.9261	752.7716	731.1469	700.8279	666.2955	635.0940	574.7850	510.8812	485.2201	(84)

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

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	25.4903	25.5580	25.6247	25.9426	26.0030	26.2878	26.2878	26.3412	26.1774	26.0030	25.8812	25.7550	
util living area	2.6994	2.7039	2.7083	2.7295	2.7335	2.7525	2.7525	2.7561	2.7452	2.7335	2.7254	2.7170	
	0.9675	0.9493	0.9210	0.8696	0.7839	0.6538	0.5196	0.5571	0.7378	0.8879	0.9518	0.9721	(86)
MIT	18.7161	19.0026	19.4186	19.9394	20.4078	20.7556	20.9066	20.8840	20.6331	20.0249	19.2774	18.6639	(87)
Th 2	20.0703	20.0725	20.0747	20.0850	20.0869	20.0959	20.0959	20.0976	20.0925	20.0869	20.0830	20.0789	(88)
util rest of house	0.9630	0.9423	0.9099	0.8499	0.7484	0.5922	0.4316	0.4708	0.6846	0.8669	0.9441	0.9683	(89)
MIT 2	17.9664	18.2505	18.6610	19.1745	19.6182	19.9334	20.0493	20.0366	19.8322	19.2661	18.5328	17.9209	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	18.1169	18.4015	18.8131	19.3281	19.7768	20.0984	20.2214	20.2067	19.9930	19.4184	18.6823	18.0700	(92)
Temperature adjustment	0.0000												
adjusted MIT	18.1169	18.4015	18.8131	19.3281	19.7768	20.0984	20.2214	20.2067	19.9930	19.4184	18.6823	18.0700	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	490.5438	562.8687	601.0298	603.0167	553.1520	433.1435	311.5543	321.1175	430.6070	487.6670	474.4696	464.2998	(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	1323.2825	1289.6471	1173.0685	981.3083	758.2797	510.6231	336.3105	352.8027	549.5725	827.9091	1092.5071	1314.7143	(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	619.5576	488.3951	425.5968	272.3700	152.6150	0.0000	0.0000	0.0000	0.0000	253.1401	444.9870	632.7084	(98)
Space heating	3289.3701 (98)												
Space heating per m2	(98) / (4) =												
	34.8857 (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	
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	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7663	0.8295	0.8097	0.0000	0.0000	0.0000	0.0000	(100)
	0.0000	0.0000	0.0000	0.0000	0.0000	872.9484	687.2147	704.3566	0.0000	0.0000	0.0000	0.0000	(101)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	668.9432	570.0470	570.3468	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	957.1206	919.5749	881.2439	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	207.4878	260.0488	231.3074	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												698.8440 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	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	51.8719	65.0122	57.8269	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												174.7110 (107)
Space cooling per m2												1.8529 (108)
Energy for space heating												34.8857 (99)
Energy for space cooling												1.8529 (108)
Total												36.7386 (109)
Dwelling Fabric Energy Efficiency (DFEE)												36.7 (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	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (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) =	0.1255 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate					0.3755 (18)							
Number of sides sheltered				2	(19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3192 (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	0.4069	0.3990	0.3910	0.3511	0.3431	0.3032	0.3032	0.2952	0.3192	0.3431	0.3591	0.3750 (22b)
Effective ac	0.5828	0.5796	0.5764	0.5616	0.5589	0.5460	0.5460	0.5436	0.5509	0.5589	0.5645	0.5703 (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			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			12.2900	1.3258	16.3068		(27)					
Flr - Ground			47.1450	0.1300	6.1289		(28a)					
Brick	44.2450	11.5330	32.7120	0.1800	5.8882		(29a)					
Render	11.3530	2.8800	8.4730	0.1800	1.5251		(29a)					
Rf - Ins Joist	47.1450		47.1450	0.1300	6.1289		(30)					
Total net area of external elements Aum(A, m2)			149.8950				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =		38.0978 (33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0304 (36)					
Total fabric heat loss							(33) + (36) = 47.1282 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 45.9791	Feb 45.7254	Mar 45.4768	Apr 44.3090	May 44.0905	Jun 43.0734	Jul 43.0734	Aug 42.8850	Sep 43.4652	Oct 44.0905	Nov 44.5325	Dec 44.9946 (38)
Heat transfer coeff	93.1073	92.8537	92.6050	91.4372	91.2188	90.2016	90.2016	90.0133	90.5934	91.2188	91.6608	92.1229 (39)
Average = Sum(39)m / 12 =												91.4362 (39)
HLP	Jan 0.9875	Feb 0.9848	Mar 0.9821	Apr 0.9697	May 0.9674	Jun 0.9566	Jul 0.9566	Aug 0.9546	Sep 0.9608	Oct 0.9674	Nov 0.9721	Dec 0.9770 (40)
HLP (average)												0.9697 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (45)
Energy content (annual)												Total = Sum(45)m = 1539.5649 (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	33.9192	29.6660	30.6126	26.6888	25.6086	22.0983	20.4773	23.4980	23.7786	27.7117	30.2495	32.8490	32.8490	(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	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	134.0005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.9728	21.2925	17.3162	13.1095	9.7995	8.2731	8.9394	11.6198	15.5961	19.8028	23.1128	24.6391	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7528	249.3133	242.8608	229.1244	211.7846	195.4876	184.6002	182.0397	188.4921	202.2286	219.5684	235.8654	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	36.4000	(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)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)
Water heating gains (Table 5)	45.5904	44.1458	41.1460	37.0678	34.4201	30.6920	27.5232	31.5833	33.0259	37.2469	42.0132	44.1518	(72)
Total internal gains	379.5161	377.9517	364.5232	342.5018	319.2043	297.6529	284.2630	288.4429	300.3142	322.4784	347.8944	367.8565	(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	5.5160	10.6334	0.6300	0.7000	0.7700	17.9254 (74)							
South	6.7760	46.7521	0.6300	0.7000	0.7700	96.8158 (78)							
Solar gains	114.7411	192.8155	260.1862	321.7770	363.8318	363.7624	349.5616	317.0943	280.9752	211.7987	136.8729	98.6012	(83)
Total gains	494.2572	570.7672	624.7093	664.2788	683.0361	661.4152	633.8246	605.5372	581.2894	534.2770	484.7674	466.4576	(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)	0.9990	0.9974	0.9932	0.9783	0.9278	0.7900	0.6103	0.6585	0.8825	0.9839	0.9976	0.9993	(86)
MIT	19.9108	20.0494	20.2579	20.5299	20.7789	20.9434	20.9896	20.9842	20.8843	20.5642	20.1863	19.8877	(87)
Th 2	20.0938	20.0960	20.0983	20.1086	20.1106	20.1196	20.1196	20.1213	20.1161	20.1106	20.1066	20.1025	(88)
util rest of house	0.9987	0.9966	0.9907	0.9696	0.8973	0.7114	0.4964	0.5453	0.8245	0.9758	0.9967	0.9990	(89)
MIT 2	19.0911	19.2312	19.4403	19.7165	19.9516	20.0914	20.1167	20.1164	20.0483	19.7539	19.3768	19.0751	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	19.2556	19.3954	19.6045	19.8798	20.1177	20.2624	20.2920	20.2906	20.2162	19.9166	19.5393	19.2383	(92)
Temperature adjustment	0.0000												
adjusted MIT	19.2556	19.3954	19.6045	19.8798	20.1177	20.2624	20.2920	20.2906	20.2162	19.9166	19.5393	19.2383	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	493.3759	568.2892	617.8080	642.2321	613.0993	479.7523	329.2889	344.0622	483.7063	520.1405	482.7444	465.8580	(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	1392.4805	1345.9555	1213.5401	1003.9604	767.8512	510.7620	333.0216	350.2067	554.0833	849.8478	1140.1950	1385.3700	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	668.9338	522.5918	443.2247	260.4444	115.1354	0.0000	0.0000	0.0000	0.0000	245.3023	473.3644	684.1169	(98)
Space heating	3413.1136 (98)												
Space heating per m2	(98) / (4) = 36.1980 (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	847.8953	667.4921	684.1009	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8672	0.9327	0.9157	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	735.2879	622.5702	626.4489	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	875.6844	841.3332	810.3238	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	101.0854	162.7596	136.8029	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling	400.6479 (104)												

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## Calculation Type: New Build (As Designed)

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

Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	25.2714	40.6899	34.2007	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											100.1620 (107)	
Space cooling per m2											1.0623 (108)	
Energy for space heating											36.1980 (99)	
Energy for space cooling											1.0623 (108)	
Total											37.2603 (109)	
Target Fabric Energy Efficiency (TFEE)											42.8 (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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				2 * 10 =	20.0000 (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) =				20.0000 / (5) =	0.0837 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3337 (18)							
Number of sides sheltered					2 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2836 (21)							
Wind speed	Jan 5.7000	Feb 5.2000	Mar 4.9000	Apr 4.5000	May 4.6000	Jun 4.2000	Jul 4.3000	Aug 4.2000	Sep 4.5000	Oct 4.9000	Nov 4.9000	Dec 5.2000 (22)
Wind factor	1.4250	1.3000	1.2250	1.1250	1.1500	1.0500	1.0750	1.0500	1.1250	1.2250	1.2250	1.3000 (22a)
Adj infilt rate	0.4041	0.3687	0.3474	0.3191	0.3261	0.2978	0.3049	0.2978	0.3191	0.3474	0.3474	0.3687 (22b)
Effective ac	0.5817	0.5680	0.5604	0.5509	0.5532	0.5443	0.5465	0.5443	0.5509	0.5604	0.5604	0.5680 (25)

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

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss							(33) + (36) = 49.7935 (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	45.8898	44.8091	44.2082	43.4626	43.6430	42.9450	43.1136	42.9450	43.4626	44.2082	44.2082	44.8091 (38)
Average = Sum(39)m / 12 =	95.6833	94.6025	94.0017	93.2560	93.4365	92.7385	92.9070	92.7385	93.2560	94.0017	94.0017	94.6025 (39)
HLP	1.0148	1.0033	0.9969	0.9890	0.9909	0.9835	0.9853	0.9835	0.9890	0.9969	0.9969	1.0033 (40)
HLP (average)												0.9945 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (45)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m														
	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875	23.1875	(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	14.6958	13.2599	14.6483	14.1196	14.5494	14.0330	14.4715	14.5220	14.0802	14.6074	14.1854	14.6807	14.6807	(61)
Total heat required for water heating calculated for each month	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641	(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	(63)
Solar input (sum of months) = Sum(63)m =													0.0000 (63)	
Output from w/h	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641	(64)
Total per year (kWh/year) = Sum(64)m =													1711.4180 (64)	
RHI water heating demand													1711 (64)	
Heat gains from water heating, kWh/month	56.7476	49.7335	51.5618	45.2901	43.7073	38.0855	35.6588	40.3979	40.7266	47.0125	50.8779	55.0691	55.0691	(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	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5603	52.9009	43.0219	32.5704	24.3467	20.5545	22.2099	28.8693	38.7483	49.1998	57.4235	61.2157	61.2157	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.2877	372.1094	362.4789	341.9767	316.0964	291.7725	275.5227	271.7010	281.3315	301.8337	327.7140	352.0379	352.0379	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	(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	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)
Water heating gains (Table 5)	76.2736	74.0082	69.3035	62.9029	58.7463	52.8966	47.9285	54.2983	56.5647	63.1888	70.6637	74.0177	74.0177	(72)
Total internal gains	614.4818	609.3787	585.1646	547.8102	509.5496	475.5839	456.0213	465.2288	487.0047	524.5826	566.1614	597.6314	597.6314	(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		5.5160	13.4530	0.7300	0.7200	0.7700	27.0292 (74)							
South		6.7760	56.4170	0.7300	0.7200	0.7700	139.2426 (78)							
Solar gains	166.2718	241.8716	331.2842	431.1319	474.8129	516.1714	484.6118	441.2493	380.6105	285.8485	197.6818	140.4882	140.4882	(83)
Total gains	780.7536	851.2503	916.4488	978.9421	984.3626	991.7552	940.6331	906.4781	867.6152	810.4311	763.8432	738.1196	738.1196	(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	25.5140	25.8055	25.9705	26.1781	26.1276	26.3242	26.2765	26.3242	26.1781	25.9705	25.9705	25.8055	25.8055	
alpha	2.7009	2.7204	2.7314	2.7452	2.7418	2.7549	2.7518	2.7549	2.7452	2.7314	2.7314	2.7204	2.7204	
util living area	0.9089	0.8885	0.8456	0.7655	0.6454	0.4845	0.3676	0.3531	0.5530	0.7475	0.8630	0.9157	0.9157	(86)
MIT	19.3736	19.5387	19.8881	20.3223	20.6865	20.8988	20.9651	20.9710	20.8522	20.4977	19.9411	19.3708	19.3708	(87)
Th 2	20.0710	20.0806	20.0859	20.0925	20.0909	20.0971	20.0956	20.0971	20.0925	20.0859	20.0859	20.0806	20.0806	(88)
util rest of house	0.8973	0.8749	0.8266	0.7363	0.5991	0.4200	0.2885	0.2701	0.4867	0.7081	0.8432	0.9047	0.9047	(89)
MIT 2	18.6105	18.7766	19.1173	19.5324	19.8600	20.0375	20.0810	20.0860	20.0017	19.6965	19.1750	18.6159	18.6159	(90)
Living area fraction	18.7637	18.9296	19.2721	19.6910	20.0260	20.2104	20.2585	20.2637	20.1725	19.8574	19.3288	18.7675	18.7675	(92)
Temperature adjustment												-0.1500	-0.1500	
adjusted MIT	18.6137	18.7796	19.1221	19.5410	19.8760	20.0604	20.1085	20.1137	20.0225	19.7074	19.1788	18.6175	18.6175	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	0.8750	0.8518	0.8034	0.7165	0.5873	0.4172	0.2897	0.2717	0.4813	0.6898	0.8199	0.8830	0.8830	(94)
Ext temp.	683.1323	725.1344	736.2551	701.4116	578.1566	413.8027	272.4709	246.2957	417.5720	559.0172	626.2689	651.7919	651.7919	(95)
Heat loss rate W	5.4000	5.6000	7.1000	9.5000	12.6000	15.3000	17.1000	17.4000	15.1000	12.0000	8.6000	5.6000	5.6000	(96)
Month fracti	1264.3324	1246.8224	1130.0973	936.3844	679.8410	441.4740	279.5118	251.6648	459.0513	724.5056	994.4258	1231.4870	1231.4870	(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	1.0000	(97a)
RHI space heating demand	432.4129	350.5743	293.0186	169.1804	75.6532	0.0000	0.0000	0.0000	0.0000	123.1233	265.0730	431.2932	431.2932	(98)
													2140.3289 (98)	
													2140 (98)	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

# 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	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (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				2 * 10 =	20.0000 (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) =				20.0000 / (5) =	0.0837 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3337 (18)							
Number of sides sheltered					2 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2836 (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	0.3616	0.3545	0.3474	0.3120	0.3049	0.2694	0.2694	0.2623	0.2836	0.3049	0.3191	0.3332 (22b)
Effective ac	0.5654	0.5628	0.5604	0.5487	0.5465	0.5363	0.5363	0.5344	0.5402	0.5465	0.5509	0.5555 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m2)			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss							(33) + (36) = 49.7935 (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	44.6048	44.4045	44.2082	43.2861	43.1136	42.3104	42.3104	42.1617	42.6198	43.1136	43.4626	43.8275 (38)
Average = Sum(39)m / 12 =	94.3983	94.1980	94.0017	93.0795	92.9070	92.1039	92.1039	91.9552	92.4132	92.9070	93.2560	93.6209 (39)
HLP	1.0011	0.9990	0.9969	0.9872	0.9853	0.9768	0.9768	0.9752	0.9801	0.9853	0.9890	0.9929 (40)
HLP (average)												0.9872 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875	23.1875 (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	14.6958	13.2599	14.6483	14.1196	14.5494	14.0330	14.4715	14.5220	14.0802	14.6074	14.1854	14.6807	14.6807 (61)
Total heat required for water heating calculated for each month	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641 (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 (63)
												Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641 (64)
												Total per year (kWh/year) = Sum(64)m =	1711.4180 (64)
Heat gains from water heating, kWh/month	56.7476	49.7335	51.5618	45.2901	43.7073	38.0855	35.6588	40.3979	40.7266	47.0125	50.8779	55.0691	55.0691 (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	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5603	52.9009	43.0219	32.5704	24.3467	20.5545	22.2099	28.8693	38.7483	49.1998	57.4235	61.2157	61.2157 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.2877	372.1094	362.4789	341.9767	316.0964	291.7725	275.5227	271.7010	281.3315	301.8337	327.7140	352.0379	352.0379 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601 (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	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004 (71)
Water heating gains (Table 5)	76.2736	74.0082	69.3035	62.9029	58.7463	52.8966	47.9285	54.2983	56.5647	63.1888	70.6637	74.0177	74.0177 (72)
Total internal gains	614.4818	609.3787	585.1646	547.8102	509.5496	475.5839	456.0213	465.2288	487.0047	524.5826	566.1614	597.6314	597.6314 (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		5.5160	10.6334	0.7300	0.7200	0.7700	21.3641	(74)					
South		6.7760	46.7521	0.7300	0.7200	0.7700	115.3886	(78)					
Solar gains	136.7527	229.8046	310.0994	383.5056	433.6281	433.5453	416.6204	377.9247	334.8766	252.4294	163.1302	117.5165	(83)
Total gains	751.2345	839.1834	895.2640	931.3158	943.1777	909.1292	872.6417	843.1535	821.8813	777.0120	729.2916	715.1479	(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	25.8614	25.9163	25.9705	26.2278	26.2765	26.5056	26.5056	26.5485	26.4169	26.2765	26.1781	26.0761	26.0761 (85)
alpha	2.7241	2.7278	2.7314	2.7485	2.7518	2.7670	2.7670	2.7699	2.7611	2.7518	2.7452	2.7384	2.7384 (85)
util living area	0.9258	0.9001	0.8625	0.7985	0.7006	0.5629	0.4329	0.4617	0.6355	0.8075	0.8980	0.9335	0.9335 (86)
MIT	19.1608	19.4094	19.7644	20.1970	20.5730	20.8363	20.9420	20.9290	20.7573	20.2884	19.6548	19.1041	19.1041 (87)
Th 2	20.0824	20.0841	20.0859	20.0940	20.0956	20.1027	20.1027	20.1040	20.1000	20.0956	20.0925	20.0893	20.0893 (88)
util rest of house	0.9167	0.8882	0.8457	0.7729	0.6606	0.5024	0.3545	0.3837	0.5788	0.7781	0.8839	0.9253	0.9253 (89)
MIT 2	18.4098	18.6529	18.9986	19.4180	19.7658	19.9972	20.0747	20.0681	19.9341	19.5125	18.9031	18.3596	18.3596 (90)
Living area fraction												fLA = Living area / (4) =	0.2008 (91)
MIT	18.5606	18.8048	19.1523	19.5744	19.9279	20.1657	20.2489	20.2409	20.0994	19.6683	19.0540	18.5091	18.5091 (92)
Temperature adjustment													-0.1500
adjusted MIT	18.4106	18.6548	19.0023	19.4244	19.7779	20.0157	20.0989	20.0909	19.9494	19.5183	18.9040	18.3591	18.3591 (93)

#### 8. Space heating requirement

Utilisation	0.8961	0.8657	0.8223	0.7515	0.6452	0.4962	0.3541	0.3825	0.5685	0.7566	0.8613	0.9056	0.9056 (94)
Useful gains	673.1649	726.4402	736.2133	699.8618	608.4950	451.0647	309.0388	322.5466	467.2049	587.8542	628.1677	647.6572	647.6572 (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	4.2000 (96)
Heat loss rate W	1332.0118	1295.6755	1175.2390	979.6035	750.4933	498.8039	322.2589	339.3990	540.5629	828.5737	1100.7989	1325.5901	1325.5901 (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	1.0000 (97a)
Space heating kWh	490.1821	382.5261	326.6351	201.4140	105.6467	0.0000	0.0000	0.0000	0.0000	179.0953	340.2945	504.3821	504.3821 (98)
Space heating												2530.1759 (98)	
Space heating per m <sup>2</sup>												(98) / (4) =	26.8340 (99)

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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													2795.7744 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	490.1821	382.5261	326.6351	201.4140	105.6467	0.0000	0.0000	0.0000	0.0000	179.0953	340.2945	504.3821	(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)	541.6377	422.6808	360.9228	222.5569	116.7367	0.0000	0.0000	0.0000	0.0000	197.8953	376.0160	557.3283	(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	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	(64)
Efficiency of water heater (217)m	89.6381	89.5627	89.4281	89.1614	88.6762	87.3000	87.3000	87.3000	87.3000	89.0397	89.4668	87.3000	(216)
Fuel for water heating, kWh/month	194.4662	170.6789	177.4697	156.6979	152.3074	135.1945	126.9590	143.2998	144.3065	162.8659	174.9653	188.7547	(219)
Water heating fuel used													1927.9658 (219)
Annual totals kWh/year													
Space heating fuel - main system													2795.7744 (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)													420.7414 (232)
Total delivered energy for all uses													5219.4816 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2795.7744	3.4800	97.2929 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1927.9658	3.4800	67.0932 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	420.7414	13.1900	55.4958 (250)
Additional standing charges			120.0000 (251)
Total energy cost			349.7744 (255)

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

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0547 (257)
SAP value		85.2873
SAP rating (Section 12)		85 (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	2795.7744	0.2160	603.8873 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1927.9658	0.2160	416.4406 (264)
Space and water heating			1020.3279 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	420.7414	0.5190	218.3648 (268)
Total kg/year			1277.6177 (272)
CO2 emissions per m2			13.5500 (273)
EI value			87.7090
EI rating			88 (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	$3.48 / 0.8865 = 3.925$ , stars = 4
Water heating environmental impact	$0.216 / 0.8865 = 0.2436$ , 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				2 * 10 =	20.0000 (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) =				20.0000 / (5) =	0.0837 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3337 (18)							
Number of sides sheltered					2 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2836 (21)							
Wind speed	Jan 5.7000	Feb 5.2000	Mar 4.9000	Apr 4.5000	May 4.6000	Jun 4.2000	Jul 4.3000	Aug 4.2000	Sep 4.5000	Oct 4.9000	Nov 4.9000	Dec 5.2000 (22)
Wind factor	1.4250	1.3000	1.2250	1.1250	1.1500	1.0500	1.0750	1.0500	1.1250	1.2250	1.2250	1.3000 (22a)
Adj infilt rate	0.4041	0.3687	0.3474	0.3191	0.3261	0.2978	0.3049	0.2978	0.3191	0.3474	0.3474	0.3687 (22b)
Effective ac	0.5817	0.5680	0.5604	0.5509	0.5532	0.5443	0.5465	0.5443	0.5509	0.5604	0.5604	0.5680 (25)

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

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss						(33) + (36) =	49.7935 (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	45.8898	44.8091	44.2082	43.4626	43.6430	42.9450	43.1136	42.9450	43.4626	44.2082	44.2082	44.8091 (38)
Average = Sum(39)m / 12 =	95.6833	94.6025	94.0017	93.2560	93.4365	92.7385	92.9070	92.7385	93.2560	94.0017	94.0017	94.6025 (39)
HLP	1.0148	1.0033	0.9969	0.9890	0.9909	0.9835	0.9853	0.9835	0.9890	0.9969	0.9969	1.0033 (40)
HLP (average)												0.9945 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (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 =	1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m														
	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875	23.1875	(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	14.6958	13.2599	14.6483	14.1196	14.5494	14.0330	14.4715	14.5220	14.0802	14.6074	14.1854	14.6807	14.6807	(61)
Total heat required for water heating calculated for each month	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641	(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	(63)
													Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641	(64)
													Total per year (kWh/year) = Sum(64)m =	1711.4180 (64)
Heat gains from water heating, kWh/month	56.7476	49.7335	51.5618	45.2901	43.7073	38.0855	35.6588	40.3979	40.7266	47.0125	50.8779	55.0691	55.0691	(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	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5603	52.9009	43.0219	32.5704	24.3467	20.5545	22.2099	28.8693	38.7483	49.1998	57.4235	61.2157	61.2157	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.2877	372.1094	362.4789	341.9767	316.0964	291.7725	275.5227	271.7010	281.3315	301.8337	327.7140	352.0379	352.0379	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	(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	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)
Water heating gains (Table 5)	76.2736	74.0082	69.3035	62.9029	58.7463	52.8966	47.9285	54.2983	56.5647	63.1888	70.6637	74.0177	74.0177	(72)
Total internal gains	614.4818	609.3787	585.1646	547.8102	509.5496	475.5839	456.0213	465.2288	487.0047	524.5826	566.1614	597.6314	597.6314	(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		5.5160	13.4530	0.7300	0.7200	0.7700	27.0292 (74)							
South		6.7760	56.4170	0.7300	0.7200	0.7700	139.2426 (78)							
Solar gains	166.2718	241.8716	331.2842	431.1319	474.8129	516.1714	484.6118	441.2493	380.6105	285.8485	197.6818	140.4882	140.4882	(83)
Total gains	780.7536	851.2503	916.4488	978.9421	984.3626	991.7552	940.6331	906.4781	867.6152	810.4311	763.8432	738.1196	738.1196	(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	25.5140	25.8055	25.9705	26.1781	26.1276	26.3242	26.2765	26.3242	26.1781	25.9705	25.9705	25.8055	25.8055	
alpha	2.7009	2.7204	2.7314	2.7452	2.7418	2.7549	2.7518	2.7549	2.7452	2.7314	2.7314	2.7204	2.7204	
util living area	0.9089	0.8885	0.8456	0.7655	0.6454	0.4845	0.3676	0.3531	0.5530	0.7475	0.8630	0.9157	0.9157	(86)
MIT	19.3736	19.5387	19.8881	20.3223	20.6865	20.8988	20.9651	20.9710	20.8522	20.4977	19.9411	19.3708	19.3708	(87)
Th 2	20.0710	20.0806	20.0859	20.0925	20.0909	20.0971	20.0956	20.0971	20.0925	20.0859	20.0859	20.0806	20.0806	(88)
util rest of house	0.8973	0.8749	0.8266	0.7363	0.5991	0.4200	0.2885	0.2701	0.4867	0.7081	0.8432	0.9047	0.9047	(89)
MIT 2	18.6105	18.7766	19.1173	19.5324	19.8600	20.0375	20.0810	20.0860	20.0017	19.6965	19.1750	18.6159	18.6159	(90)
Living area fraction													fLA = Living area / (4) =	0.2008 (91)
MIT	18.7637	18.9296	19.2721	19.6910	20.0260	20.2104	20.2585	20.2637	20.1725	19.8574	19.3288	18.7675	18.7675	(92)
Temperature adjustment													-0.1500	
adjusted MIT	18.6137	18.7796	19.1221	19.5410	19.8760	20.0604	20.1085	20.1137	20.0225	19.7074	19.1788	18.6175	18.6175	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.8750	0.8518	0.8034	0.7165	0.5873	0.4172	0.2897	0.2717	0.4813	0.6898	0.8199	0.8830	0.8830	(94)
Useful gains	683.1323	725.1344	736.2551	701.4116	578.1566	413.8027	272.4709	246.2957	417.5720	559.0172	626.2689	651.7919	651.7919	(95)
Ext temp.	5.4000	5.6000	7.1000	9.5000	12.6000	15.3000	17.1000	17.4000	15.1000	12.0000	8.6000	5.6000	5.6000	(96)
Heat loss rate W	1264.3324	1246.8224	1130.0973	936.3844	679.8410	441.4740	279.5118	251.6648	459.0513	724.5056	994.4258	1231.4870	1231.4870	(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	1.0000	(97a)
Space heating kWh	432.4129	350.5743	293.0186	169.1804	75.6532	0.0000	0.0000	0.0000	0.0000	123.1233	265.0730	431.2932	431.2932	(98)
Space heating													2140.3289 (98)	
Space heating per m2													(98) / (4) =	22.6994 (99)

#### 8c. Space cooling requirement



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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													2365.0043 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	432.4129	350.5743	293.0186	169.1804	75.6532	0.0000	0.0000	0.0000	0.0000	123.1233	265.0730	431.2932	(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)	477.8043	387.3749	323.7775	186.9397	83.5947	0.0000	0.0000	0.0000	0.0000	136.0479	292.8983	476.5670	(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	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	(64)
Efficiency of water heater (217)m	89.5569	89.5038	89.3493	89.0240	88.4225	87.3000	87.3000	87.3000	87.3000	88.7408	89.2849	87.3000	(216)
Fuel for water heating, kWh/month	194.6425	170.7911	177.6261	156.9398	152.7443	135.1945	126.9590	143.2998	144.3065	163.4145	175.3218	188.9643	(219)
Water heating fuel used													1930.2042 (219)
Annual totals kWh/year													
Space heating fuel - main system													2365.0043 (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)													420.7414 (232)
Total delivered energy for all uses													4790.9498 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2365.0043	4.2600	100.7492 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1930.2042	4.2600	82.2267 (247)
Pumps and fans for heating	75.0000	22.5500	16.9125 (249)
Energy for lighting	420.7414	22.5500	94.8772 (250)
Additional standing charges			96.0000 (251)
Total energy cost			390.7656 (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	2365.0043	0.2160	510.8409 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1930.2042	0.2160	416.9241 (264)
Space and water heating			927.7650 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	420.7414	0.5190	218.3648 (268)
Total kg/year			1185.0548 (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	2365.0043	1.2200	2885.3052 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1930.2042	1.2200	2354.8491 (264)
Space and water heating			5240.1543 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	420.7414	3.0700	1291.6760 (268)
Primary energy kWh/year			6762.0803 (272)
Primary energy kWh/m2/year			71.7158 (273)

#### SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85  
 Current environmental impact rating: B 88

# 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	-£ 32	-193 kg (16.3%)
U Solar photovoltaic panels	+ 9.6	-£ 453	-1042 kg (105.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£32	2.04 kg/m <sup>2</sup>	B 86 B 89
Solar photovoltaic panels	£453	11.05 kg/m <sup>2</sup>	A 96 A 98
<b>Total Savings</b>	<b>£484</b>	<b>13.09 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 96  
 Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£112	£123	-£11
Mains gas	£279	£236	£43
Space heating	£214	£214	£0
Water heating	£82	£50	£32
Lighting	£95	£95	£0
Generated (PV)	-£0	-£453	£453
<b>Total cost of fuels</b>	<b>£391</b>	<b>-£94</b>	<b>£485</b>
<b>Total cost of uses</b>	<b>£391</b>	<b>-£94</b>	<b>£485</b>
Delivered energy	51 kWh/m <sup>2</sup>	19 kWh/m <sup>2</sup>	31 kWh/m <sup>2</sup>
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.2 tonnes
CO2 emissions per m <sup>2</sup>	13 kg/m <sup>2</sup>	-1 kg/m <sup>2</sup>	13 kg/m <sup>2</sup>
Primary energy	72 kWh/m <sup>2</sup>	-5 kWh/m <sup>2</sup>	77 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	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (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				2 * 10 =	20.0000 (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) =				20.0000 / (5) =	0.0837 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3337 (18)							
Number of sides sheltered					2 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2836 (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	0.3616	0.3545	0.3474	0.3120	0.3049	0.2694	0.2694	0.2623	0.2836	0.3049	0.3191	0.3332 (22b)
Effective ac	0.5654	0.5628	0.5604	0.5487	0.5465	0.5363	0.5363	0.5344	0.5402	0.5465	0.5509	0.5555 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m2)			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss							(33) + (36) = 49.7935 (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	44.6048	44.4045	44.2082	43.2861	43.1136	42.3104	42.3104	42.1617	42.6198	43.1136	43.4626	43.8275 (38)
Average = Sum(39)m / 12 =	94.3983	94.1980	94.0017	93.0795	92.9070	92.1039	92.1039	91.9552	92.4132	92.9070	93.2560	93.6209 (39)
HLP	1.0011	0.9990	0.9969	0.9872	0.9853	0.9768	0.9768	0.9752	0.9801	0.9853	0.9890	0.9929 (40)
HLP (average)												0.9872 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (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 =	1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875	23.1875 (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	14.6958	13.2599	14.6483	14.1196	14.5494	14.0330	14.4715	14.5220	14.0802	14.6074	14.1854	14.6807	14.6807 (61)
Total heat required for water heating calculated for each month													
	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	169.2641 (62)
Aperture area of solar collector													
Zero-loss collector efficiency													3.0000 (H1)
Collector heat loss coefficient													0.7000 (H2)
Collector 2nd order heat loss coefficient													1.8000 (H3)
Collector effective heat loss coefficient													0.0050 (H3a)
Collector performance ratio													1.8063 (H3b)
Annual solar radiation per m2													2.5804 (H4)
Overshading factor													1079.5246 (H5)
Solar energy available													0.8000 (H6)
Adjustment factor for showers													1813.6014 (H7)
Solar-to-load ratio													1.0000 (H7a)
Utilisation factor													1.1780 (H8)
Collector performance factor													0.5721 (H9)
Dedicated solar storage volume													0.8793 (H10)
Effective solar volume													75.0000 (H11)
Daily hot water demand													75.0000 (H13)
Volume ratio Veff/V													97.8502 (H14)
Solar storage volume factor													0.7665 (H15)
Solar input													0.9468 (H16)
Solar input	-25.0490	-41.7995	-71.1893	-95.4077	-117.8682	-115.8832	-114.3518	-99.9097	-78.2494	-53.4351	-29.7117	-20.9617	-863.8162 (H17)
													-863.8162 (63)
Solar input (sum of months) = Sum(63)m =													
Output from w/h	149.2668	111.0650	87.5184	44.3064	17.1922	2.1416	0.0000	25.1910	47.7302	91.5802	126.8242	148.3024	148.3024 (64)
Total per year (kWh/year) = Sum(64)m =													851.1184 (64)
Heat gains from water heating, kWh/month													
	56.7476	49.7335	51.5618	45.2901	43.7073	38.0855	35.6588	40.3979	40.7266	47.0125	50.8779	55.0691	55.0691 (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	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5603	52.9009	43.0219	32.5704	24.3467	20.5545	22.2099	28.8693	38.7483	49.1998	57.4235	61.2157	61.2157 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.2877	372.1094	362.4789	341.9767	316.0964	291.7725	275.5227	271.7010	281.3315	301.8337	327.7140	352.0379	352.0379 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601 (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	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004 (71)
Water heating gains (Table 5)	76.2736	74.0082	69.3035	62.9029	58.7463	52.8966	47.9285	54.2983	56.5647	63.1888	70.6637	74.0177	74.0177 (72)
Total internal gains	614.4818	609.3787	585.1646	547.8102	509.5496	475.5839	456.0213	465.2288	487.0047	524.5826	566.1614	597.6314	597.6314 (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	5.5160	10.6334	0.7300	0.7200	0.7700	21.3641 (74)							
South	6.7760	46.7521	0.7300	0.7200	0.7700	115.3886 (78)							
Solar gains	136.7527	229.8046	310.0994	383.5056	433.6281	433.5453	416.6204	377.9247	334.8766	252.4294	163.1302	117.5165	117.5165 (83)
Total gains	751.2345	839.1834	895.2640	931.3158	943.1777	909.1292	872.6417	843.1535	821.8813	777.0120	729.2916	715.1479	715.1479 (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	25.8614	25.9163	25.9705	26.2278	26.2765	26.5056	26.5056	26.5485	26.4169	26.2765	26.1781	26.0761	26.0761 (87)
alpha	2.7241	2.7278	2.7314	2.7485	2.7518	2.7670	2.7670	2.7699	2.7611	2.7518	2.7452	2.7384	2.7384 (88)
util living area	0.9258	0.9001	0.8625	0.7985	0.7006	0.5629	0.4329	0.4617	0.6355	0.8075	0.8980	0.9335	0.9335 (86)
MIT	19.1608	19.4094	19.7644	20.1970	20.5730	20.8363	20.9420	20.9290	20.7573	20.2884	19.6548	19.1041	19.1041 (87)
Th 2	20.0824	20.0841	20.0859	20.0940	20.0956	20.1027	20.1027	20.1040	20.1000	20.0956	20.0925	20.0893	20.0893 (88)
util rest of house	0.9167	0.8882	0.8457	0.7729	0.6606	0.5024	0.3545	0.3837	0.5788	0.7781	0.8839	0.9253	0.9253 (89)
MIT 2	18.4098	18.6529	18.9986	19.4180	19.7658	19.9972	20.0747	20.0681	19.9341	19.5125	18.9031	18.3596	18.3596 (90)
Living area fraction												0.2008 (91)	
MIT	18.5606	18.8048	19.1523	19.5744	19.9279	20.1657	20.2489	20.2409	20.0994	19.6683	19.0540	18.5091	18.5091 (92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4106	18.6548	19.0023	19.4244	19.7779	20.0157	20.0989	20.0909	19.9494	19.5183	18.9040	18.3591	18.3591 (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	0.8961	0.8657	0.8223	0.7515	0.6452	0.4962	0.3541	0.3825	0.5685	0.7566	0.8613	0.9056	(94)
Useful gains	673.1649	726.4402	736.2133	699.8618	608.4950	451.0647	309.0388	322.5466	467.2049	587.8542	628.1677	647.6572	(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													
	1332.0118	1295.6755	1175.2390	979.6035	750.4933	498.8039	322.2589	339.3990	540.5629	828.5737	1100.7989	1325.5901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	490.1821	382.5261	326.6351	201.4140	105.6467	0.0000	0.0000	0.0000	0.0000	179.0953	340.2945	504.3821	(98)
Space heating												2530.1759	(98)
Space heating per m2												(98) / (4) =	26.8340 (99)

#### 8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2795.7744 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	490.1821	382.5261	326.6351	201.4140	105.6467	0.0000	0.0000	0.0000	0.0000	179.0953	340.2945	504.3821	(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)	541.6377	422.6808	360.9228	222.5569	116.7367	0.0000	0.0000	0.0000	0.0000	197.8953	376.0160	557.3283	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.2668	111.0650	87.5184	44.3064	17.1922	2.1416	0.0000	25.1910	47.7302	91.5802	126.8242	148.3024	(64)
Efficiency of water heater													87.3000 (216)
(217)m	89.7322	89.7597	89.8044	89.9058	90.0381	87.3000	87.3000	87.3000	87.3000	89.3914	89.6082	89.7525	(217)
Fuel for water heating, kWh/month	166.3469	123.7360	97.4545	49.2809	19.0943	2.4532	0.0000	28.8557	54.6738	102.4486	141.5318	165.2348	(219)
												951.1107	(219)
Water heating fuel used													
Annual totals kWh/year													
Space heating fuel - main system													2795.7744 (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)													420.7414 (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													2565.3871 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2795.7744	3.4800	97.2929	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	951.1107	3.4800	33.0987	(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	420.7414	13.1900	55.4958	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			94.5520	(255)

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

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.2851 (257)
SAP value		96.0228
SAP rating (Section 12)		96 (258)
SAP band		A

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

Energy Emission factor Emissions

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	2795.7744	0.2160	603.8873 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	951.1107	0.2160	205.4399 (264)
Space and water heating			809.3272 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	420.7414	0.5190	218.3648 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			196.1297 (272)
CO2 emissions per m2			2.0800 (273)
EI value			98.1132
EI rating			98 (274)
EI band			A

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	47.1450 (1b)	2.3850 (2b)	112.4408 (1b) - (3b)
First floor	47.1450 (1c)	2.6860 (2c)	126.6315 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2900		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 239.0723 (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				2 * 10 =	20.0000 (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) =				20.0000 / (5) =	0.0837 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3337 (18)							
Number of sides sheltered					2 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2836 (21)							
Wind speed	Jan 5.7000	Feb 5.2000	Mar 4.9000	Apr 4.5000	May 4.6000	Jun 4.2000	Jul 4.3000	Aug 4.2000	Sep 4.5000	Oct 4.9000	Nov 4.9000	Dec 5.2000 (22)
Wind factor	1.4250	1.3000	1.2250	1.1250	1.1500	1.0500	1.0750	1.0500	1.1250	1.2250	1.2250	1.3000 (22a)
Adj infilt rate	0.4041	0.3687	0.3474	0.3191	0.3261	0.2978	0.3049	0.2978	0.3191	0.3474	0.3474	0.3687 (22b)
Effective ac	0.5817	0.5680	0.5604	0.5509	0.5532	0.5443	0.5465	0.5443	0.5509	0.5604	0.5604	0.5680 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Solid Door			2.1200	1.0900	2.3108		(26)
Windows (Uw = 1.40)			12.2900	1.3258	16.3068		(27)
Flr - Ground			47.1450	0.1431	6.7460	75.6000	3564.1620 (28a)
Brick	44.2450	11.5330	32.7120	0.2500	8.1780	51.1900	1674.5273 (29a)
Render	11.3530	2.8800	8.4730	0.2500	2.1183	51.1900	433.7329 (29a)
Rf - Ins Joist	47.1450		47.1450	0.1000	4.7145	7.4000	348.8730 (30)
Total net area of external elements Aum(A, m2)			149.8950				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.3743		(33)
Party Wall			87.2220	0.0000	0.0000	7.4000	645.4428 (32)
Stud			91.2883			7.4000	675.5331 (32c)
Stud			101.1548			7.4000	748.5452 (32c)
Internal Floor			47.1450			7.4000	348.8730 (32d)
Internal Ceiling			47.1450			7.4000	348.8730 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	8788.5623 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							93.2078 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4191 (36)
Total fabric heat loss						(33) + (36) =	49.7935 (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	45.8898	44.8091	44.2082	43.4626	43.6430	42.9450	43.1136	42.9450	43.4626	44.2082	44.2082	44.8091 (38)
Average = Sum(39)m / 12 =	95.6833	94.6025	94.0017	93.2560	93.4365	92.7385	92.9070	92.7385	93.2560	94.0017	94.0017	94.6025 (39)
HLP	1.0148	1.0033	0.9969	0.9890	0.9909	0.9835	0.9853	0.9835	0.9890	0.9969	0.9969	1.0033 (40)
HLP (average)												0.9945 (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												2.6800 (42)
Average daily hot water use (litres/day)												97.8502 (43)
Daily hot water use	107.6352	103.7212	99.8072	95.8932	91.9792	88.0652	88.0652	91.9792	95.8932	99.8072	103.7212	107.6352 (44)
Energy conte	159.6199	139.6046	144.0595	125.5945	120.5109	103.9918	96.3637	110.5787	111.8994	130.4079	142.3505	154.5834 (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 =	1539.5649 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9430	20.9407	21.6089	18.8392	18.0766	15.5988	14.4546	16.5868	16.7849	19.5612	21.3526	23.1875	(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	14.6958	13.2599	14.6483	14.1196	14.5494	14.0330	14.4715	14.5220	14.0802	14.6074	14.1854	14.6807	(61)
Total heat required for water heating calculated for each month	174.3157	152.8645	158.7077	139.7141	135.0604	118.0248	110.8352	125.1008	125.9796	145.0153	156.5358	169.2641	(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												1254.2188 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												2107.0876 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.3686 (H8)	
Utilisation factor												0.5184 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												97.8502 (H14)	
Volume ratio Veff/V												0.7665 (H15)	
Solar storage volume factor												0.9468 (H16)	
Solar input	-28.4913	-41.1982	-70.9864	-99.1495	-118.2171	-125.8853	-121.5633	-107.4007	-82.7398	-56.6352	-33.6997	-909.3935	(H17)
Solar input												-23.4269 (63)	
Solar input												-909.3935 (63)	
Solar input (sum of months) = Sum(63)m =													
Output from w/h	145.8244	111.6663	87.7213	40.5647	16.8433	0.0000	0.0000	17.7001	43.2398	88.3801	122.8361	145.8371	(64)
Total per year (kWh/year) = Sum(64)m =												820.6132 (64)	
Heat gains from water heating, kWh/month	56.7476	49.7335	51.5618	45.2901	43.7073	38.0855	35.6588	40.3979	40.7266	47.0125	50.8779	55.0691	(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	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	160.8005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5603	52.9009	43.0219	32.5704	24.3467	20.5545	22.2099	28.8693	38.7483	49.1998	57.4235	61.2157	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.2877	372.1094	362.4789	341.9767	316.0964	291.7725	275.5227	271.7010	281.3315	301.8337	327.7140	352.0379	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	53.7601	(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)	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	-107.2004	(71)
Water heating gains (Table 5)	76.2736	74.0082	69.3035	62.9029	58.7463	52.8966	47.9285	54.2983	56.5647	63.1888	70.6637	74.0177	(72)
Total internal gains	614.4818	609.3787	585.1646	547.8102	509.5496	475.5839	456.0213	465.2288	487.0047	524.5826	566.1614	597.6314	(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	5.5160	13.4530	0.7300	0.7200	0.7700	27.0292 (74)							
South	6.7760	56.4170	0.7300	0.7200	0.7700	139.2426 (78)							
Solar gains	166.2718	241.8716	331.2842	431.1319	474.8129	516.1714	484.6118	441.2493	380.6105	285.8485	197.6818	140.4882	(83)
Total gains	780.7536	851.2503	916.4488	978.9421	984.3626	991.7552	940.6331	906.4781	867.6152	810.4311	763.8432	738.1196	(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	25.5140	25.8055	25.9705	26.1781	26.1276	26.3242	26.2765	26.3242	26.1781	25.9705	25.9705	25.8055	
alpha	2.7009	2.7204	2.7314	2.7418	2.7452	2.7549	2.7518	2.7549	2.7452	2.7314	2.7314	2.7204	
util living area	0.9089	0.8885	0.8456	0.7655	0.6454	0.4845	0.3676	0.3531	0.5530	0.7475	0.8630	0.9157	(86)
MIT	19.3736	19.5387	19.8881	20.3223	20.6865	20.8988	20.9651	20.9710	20.8522	20.4977	19.9411	19.3708	(87)
Th 2	20.0710	20.0806	20.0859	20.0925	20.0909	20.0971	20.0956	20.0971	20.0925	20.0859	20.0859	20.0806	(88)
util rest of house	0.8973	0.8749	0.8266	0.7363	0.5991	0.4200	0.2885	0.2701	0.4867	0.7081	0.8432	0.9047	(89)
MIT 2	18.6105	18.7766	19.1173	19.5324	19.8600	20.0375	20.0810	20.0860	20.0017	19.6965	19.1750	18.6159	(90)
Living area fraction												0.2008 (91)	
MIT	18.7637	18.9296	19.2721	19.6910	20.0260	20.2104	20.2585	20.2637	20.1725	19.8574	19.3288	18.7675	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6137	18.7796	19.1221	19.5410	19.8760	20.0604	20.1085	20.1137	20.0225	19.7074	19.1788	18.6175	(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	0.8750	0.8518	0.8034	0.7165	0.5873	0.4172	0.2897	0.2717	0.4813	0.6898	0.8199	0.8830	(94)
Useful gains	683.1323	725.1344	736.2551	701.4116	578.1566	413.8027	272.4709	246.2957	417.5720	559.0172	626.2689	651.7919	(95)
Ext temp.	5.4000	5.6000	7.1000	9.5000	12.6000	15.3000	17.1000	17.4000	15.1000	12.0000	8.6000	5.6000	(96)
Heat loss rate W													
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
Space heating	432.4129	350.5743	293.0186	169.1804	75.6532	0.0000	0.0000	0.0000	0.0000	123.1233	265.0730	431.2932	(98)
Space heating per m2												22.6994	(99)

#### 8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2365.0043	(211)
Space heating requirement	432.4129	350.5743	293.0186	169.1804	75.6532	0.0000	0.0000	0.0000	0.0000	123.1233	265.0730	431.2932	(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)	477.8043	387.3749	323.7775	186.9397	83.5947	0.0000	0.0000	0.0000	0.0000	136.0479	292.8983	476.5670	(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	145.8244	111.6663	87.7213	40.5647	16.8433	0.0000	0.0000	17.7001	43.2398	88.3801	122.8361	145.8371	(64)	
Efficiency of water heater	89.6711	89.7057	89.7421	89.8630	89.8999	87.3000	87.3000	87.3000	87.3000	89.1347	89.4616	89.6694	(217)	
Fuel for water heating, kWh/month	162.6215	124.4808	97.7482	45.1406	18.7356	0.0000	0.0000	20.2750	49.5301	99.1534	137.3060	162.6386	(219)	
Water heating fuel used												917.6297	(219)	
Annual totals kWh/year														
Space heating fuel - main system													2365.0043	(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)													420.7414	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 2.50 * 1254 * 0.80) =										-2006.7501			-2006.7501	(233)
Total delivered energy for all uses													1821.6253	(238)

#### 10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2365.0043	4.2600	100.7492	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	917.6297	4.2600	39.0910	(247)
Pumps and fans for heating	75.0000	22.5500	16.9125	(249)
Pump for solar water heating	50.0000	22.5500	11.2750	(249)
Energy for lighting	420.7414	22.5500	94.8772	(250)
Additional standing charges			96.0000	(251)
Energy saving/generation technologies				
PV Unit	-2006.7501	22.5500	-452.5221	(252)
Total energy cost			-93.6173	(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	2365.0043	0.2160	510.8409	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	917.6297	0.2160	198.2080	(264)
Space and water heating			709.0490	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	420.7414	0.5190	218.3648	(268)
Energy saving/generation technologies				
PV Unit	-2006.7501	0.5190	-1041.5033	(269)
Total kg/year			-49.2146	(272)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2365.0043	1.2200	2885.3052 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	917.6297	1.2200	1119.5083 (264)
Space and water heating			4004.8135 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	420.7414	3.0700	1291.6760 (268)
Energy saving/generation technologies			
PV Unit	-2006.7501	3.0700	-6160.7228 (269)
Primary energy kWh/year			-480.4833 (272)
Primary energy kWh/m2/year			-5.0958 (273)

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

#### Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	93.2 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.61 (Calculated rate)

#### Overheating Calculation

Summer ventilation heat loss coefficient	363.70 (P1)
Transmission heat loss coefficient	49.79 (37)
Summer heat loss coefficient	413.49 (P2)

#### Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	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)
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	5.5160	86.6589	0.7300	0.7200	0.7650	172.9803
South	6.7760	118.3991	0.7300	0.7200	0.7650	290.3227

total: 463.3029

Solar gains	Jun 489	Jul 463	Aug 422	(P3)
Internal gains	473	453	462	
Total summer gains	961	916	884	(P5)

Summer gain/loss ratio	2.32	2.22	2.14	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 93.2)	1.35	1.35	1.35	
Threshold temperature	19.07	20.96	20.98	(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>	629 - PRJ012992		<b>Issued on Date</b>	01/02/2023	
<b>Assessment Reference</b>	629	<b>Prop Type Ref</b>	Clover		
<b>Property</b>	Lancing Phase 2, BN15				
<b>SAP Rating</b>	85 B	<b>DER</b>	14.89	<b>TER</b>	16.06
<b>Environmental</b>	88 B	<b>% DER&lt;TER</b>	7.29		
<b>CO<sub>2</sub> Emissions (t/year)</b>	1.19	<b>DFEE</b>	36.74	<b>TFEE</b>	42.85
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	14.26		
<b>Assessor Details</b>	Chris Nicholls, , Tel: ,		<b>Assessor ID</b>	T850-0001	
<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)	16.06	kgCO <sub>2</sub> /m <sup>2</sup>		
Dwelling Carbon Dioxide Emission Rate (DER)	14.89	kgCO <sub>2</sub> /m <sup>2</sup>		Pass
	-1.17 (-7.3%)	kgCO <sub>2</sub> /m <sup>2</sup>		

##### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	42.85	kWh/m <sup>2</sup> /yr		
Dwelling Fabric Energy Efficiency (DFEE)	36.74	kWh/m <sup>2</sup> /yr		
	-6.1 (-14.3%)	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	0.25 (max. 0.30)	0.25 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass
Openings	1.35 (max. 2.00)	1.40 (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	5.00 (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 (South East England)

Slight

Pass

Based on:

Overshading

Average

Windows facing North

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

Windows facing South

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

Air change rate

4.61 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

5.00 (design value)

Maximum

10.0

Pass

### 10 Key features

Party wall U-value

0.00

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

Roof U-value

0.10

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

Door U-value

1.09

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