

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-149				Issued on Date	15/03/2018
Assessment Reference	As Built		Prop Type Ref	P306i - Det (Op)		
Property	55, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	87 B	DER	14.16	TER	18.75	
Environmental	89 B	% DER<TER	24.49			
CO ₂ Emissions (t/year)	1.00	DFEE	50.72	TFEE	57.33	
General Requirements Compliance	Pass	% DFEE<TFEE	11.53			
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk				Assessor ID	T511-0001
Client						

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

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DWELLING AS BUILT

Detached House, total floor area 93 m²

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.75 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.16 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)57.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 4.77 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Potterton Promax Ultra Combi 40 ErP
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control 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 (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.97 m², No overhang
Windows facing South East: 0.68 m², No overhang
Windows facing South: 5.76 m², No overhang
Windows facing South West: 0.68 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Door U-value 0.90 W/m²K
Thermal bridging y-value 0.036 W/m²K
Photovoltaic array 0.81 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.7700
Infiltration rate					0.4190 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.4190 (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	0.5343	0.5238	0.5133	0.4610	0.4505	0.3981	0.3981	0.3876	0.4190	0.4505	0.4714	0.4924 (22b)
Effective ac	0.6427	0.6372	0.6318	0.6062	0.6015	0.5792	0.5792	0.5751	0.5878	0.6015	0.6111	0.6212 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	46.9906	46.5854	46.1882	44.3227	43.9736	42.3488	42.3488	42.0479	42.9746	43.9736	44.6797	45.4179 (38)
Heat transfer coeff	121.5160	121.1108	120.7136	118.8480	118.4990	116.8741	116.8741	116.5732	117.5000	118.4990	119.2051	119.9433 (39)
Average = Sum(39)m / 12 =												118.8464 (39)
HLP	1.3131	1.3087	1.3044	1.2843	1.2805	1.2630	1.2630	1.2597	1.2697	1.2805	1.2881	1.2961 (40)
HLP (average)												1.2843 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
										Total per year (kWh/year) = Sum (64)m =		1777.7885 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	410.1801	407.9280	393.1245	369.2209	344.8387	321.4806	306.4099	312.7503	325.1263	349.2521	376.9382	397.8095 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
North				4.8200	10.6334	0.7100	0.7000	0.7700		17.6526 (74)		
Southeast				0.6800	36.7938	0.7100	0.7000	0.7700		8.6173 (77)		
South				5.7600	46.7521	0.7100	0.7000	0.7700		92.7498 (78)		
Southwest				0.6800	36.7938	0.7100	0.7000	0.7700		8.6173 (79)		
North				3.1500	10.6334	0.7100	0.7000	0.7700		11.5364 (74)		
Solar gains	139.1735	237.0391	328.4484	420.7117	488.7321	494.2176	472.6275	419.6277	359.5848	262.6854	166.5917	119.2271 (83)
Total gains	549.3536	644.9670	721.5729	789.9327	833.5708	815.6982	779.0373	732.3780	684.7111	611.9375	543.5299	517.0366 (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	34.3794	34.4945	34.6080	35.1512	35.2547	35.7449	35.7449	35.8371	35.5545	35.2547	35.0459	34.8302
alpha	3.2920	3.2996	3.3072	3.3434	3.3503	3.3830	3.3830	3.3891	3.3703	3.3503	3.3364	3.3220
util living area	0.9901	0.9825	0.9679	0.9343	0.8640	0.7373	0.5944	0.6407	0.8315	0.9494	0.9836	0.9919 (86)
MIT	18.9982	19.2243	19.5794	20.0500	20.4814	20.8001	20.9302	20.9086	20.6712	20.1151	19.4783	18.9672 (87)
Th 2	19.8306	19.8340	19.8374	19.8532	19.8561	19.8700	19.8700	19.8725	19.8646	19.8561	19.8501	19.8439 (88)
util rest of house	0.9877	0.9783	0.9599	0.9165	0.8235	0.6541	0.4671	0.5169	0.7670	0.9321	0.9790	0.9900 (89)
MIT 2	17.1766	17.5070	18.0229	18.7046	19.2990	19.7054	19.8334	19.8201	19.5611	18.8087	17.8886	17.1395 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.5339	17.8439	18.3282	18.9685	19.5309	19.9201	20.0485	20.0336	19.7788	19.0649	18.2004	17.4979 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3839	17.6939	18.1782	18.8185	19.3809	19.7701	19.8985	19.8836	19.6288	18.9149	18.0504	17.3479 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9800	0.9669	0.9436	0.8950	0.8028	0.6457	0.4706	0.5183	0.7505	0.9121	0.9679	0.9833 (94)
Ext temp.	538.3634	623.5916	680.8445	707.0157	669.1506	526.6635	366.6201	379.5822	513.8768	558.1534	526.0847	508.4146 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.1000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Month fracti	1589.9039	1549.4738	1409.7148	1178.7963	910.1762	604.2514	385.5103	406.0928	649.6363	985.3116	1305.3437	1577.0072 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	782.3461	622.1928	542.2795	339.6820	179.3230	0.0000	0.0000	0.0000	0.0000	317.8058	561.0665	795.0329 (98)
												4139.7287 (98)

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Space heating per m2 (98) / (4) = 44.7345 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4599.6986 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	782.3461	622.1928	542.2795	339.6820	179.3230	0.0000	0.0000	0.0000	0.0000	317.8058	561.0665	795.0329	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	869.2734	691.3254	602.5328	377.4245	199.2478	0.0000	0.0000	0.0000	0.0000	353.1175	623.4072	883.3699	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.3642	89.3120	89.2104	88.9859	88.5185	86.7000	86.7000	86.7000	86.7000	88.9116	89.2392	86.7000	(216)
Fuel for water heating, kWh/month	201.2541	176.7736	184.1684	163.1391	158.9829	142.5096	134.4811	150.8755	151.6607	169.4467	181.4643	195.5736	(219)
Water heating fuel used												2010.3295	(219)
Annual totals kWh/year													
Space heating fuel - main system												4599.6986	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1080 * 1.00) =										-699.5320		-699.5320	(233)
Total delivered energy for all uses												6384.2693	(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	4599.6986	0.2160	993.5349 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2010.3295	0.2160	434.2312 (264)
Space and water heating			1427.7661 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-699.5320	0.5190	-363.0571 (269)
Total CO2, kg/year			1310.5973 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.1600 (273)

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

DER		14.1600	ZC1
Total Floor Area		92.5400	
Assumed number of occupants		2.6589	
CO2 emission factor in Table 12 for electricity displaced from grid		0.5190	
CO2 emissions from appliances, equation (L14)		15.6036	ZC2
CO2 emissions from cooking, equation (L16)		1.9755	ZC3
Total CO2 emissions		31.7391	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.7391	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3854 (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	0.4914	0.4818	0.4721	0.4240	0.4143	0.3661	0.3661	0.3565	0.3854	0.4143	0.4336	0.4529 (22b)
Effective ac	0.6207	0.6160	0.6115	0.5899	0.5858	0.5670	0.5670	0.5635	0.5743	0.5858	0.5940	0.6025 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			1.9600	1.0000	1.9600		(26)
TER Semi-glazed door			1.8900	1.2000	2.2680		(26a)
TER Opening Type (Uw = 1.40)			15.0900	1.3258	20.0057		(27)
Heat Loss Floor			46.7700	0.1300	6.0801		(28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.1800	20.8422		(29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501		(30)
Bay	1.0100		1.0100	0.1300	0.1313		(30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.2374		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3958 (36)
Total fabric heat loss						(33) + (36) =	68.6332 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.3826	45.0398	44.7039	43.1258	42.8305	41.4560	41.4560	41.2015	41.9855	42.8305	43.4278	44.0523 (38)
Heat transfer coeff	114.0158	113.6730	113.3370	111.7590	111.4637	110.0892	110.0892	109.8347	110.6187	111.4637	112.0610	112.6854 (39)
Average = Sum(39)m / 12 =												111.7575 (39)
HLP	1.2321	1.2284	1.2247	1.2077	1.2045	1.1896	1.1896	1.1869	1.1954	1.2045	1.2109	1.2177 (40)
HLP (average)												1.2077 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum(45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (46)
Water storage loss:												
Total storage loss												

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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 (56)
Combi loss	50.9589	46.0274	50.6003	47.0477	46.6316	43.2071	44.6473	46.6316	47.0477	50.6003	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (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	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (64)
Heat gains from water heating, kWh/month	65.5416	57.6877	60.3046	53.3083	51.5226	45.2020	43.0387	48.2371	48.7780	55.7887	59.4180	63.8755 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	88.0936	85.8448	81.0546	74.0393	69.2509	62.7806	57.8477	64.8348	67.7472	74.9848	82.5250	85.8542	(72)
Total internal gains	420.2313	417.9865	403.0790	378.5364	353.5068	329.5051	314.4483	321.4315	334.4611	359.2261	387.0074	407.8680	(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				7.9700	10.6334		0.6300		0.7000		0.7700		25.9001 (74)
Southeast				0.6800	36.7938		0.6300		0.7000		0.7700		7.6464 (77)
South				5.7600	46.7521		0.6300		0.7000		0.7700		82.2991 (78)
Southwest				0.6800	36.7938		0.6300		0.7000		0.7700		7.6464 (79)
Solar gains	123.4920	210.3304	291.4401	373.3076	433.6637	438.5311	419.3737	372.3457	319.0682	233.0870	147.8208	105.7930	(83)
Total gains	543.7233	628.3169	694.5191	751.8439	787.1705	768.0362	733.8220	693.7772	653.5293	592.3131	534.8283	513.6611	(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	56.3640	56.5340	56.7016	57.5022	57.6545	58.3744	58.3744	58.5096	58.0950	57.6545	57.3472	57.0294	
alpha	4.7576	4.7689	4.7801	4.8335	4.8436	4.8916	4.8916	4.9006	4.8730	4.8436	4.8231	4.8020	
util living area	0.9982	0.9960	0.9905	0.9731	0.9207	0.7926	0.6279	0.6788	0.8872	0.9807	0.9962	0.9986	(86)
MIT	19.6388	19.7949	20.0434	20.3767	20.6866	20.9034	20.9762	20.9654	20.8153	20.4188	19.9713	19.6164	(87)
Th 2	19.8944	19.8974	19.9003	19.9139	19.9164	19.9283	19.9283	19.9305	19.9237	19.9164	19.9113	19.9059	(88)
util rest of house	0.9975	0.9946	0.9870	0.9619	0.8851	0.7031	0.4908	0.5442	0.8237	0.9706	0.9946	0.9981	(89)
MIT 2	18.0848	18.3148	18.6783	19.1671	19.5939	19.8595	19.9191	19.9154	19.7676	19.2341	18.5827	18.0600	(90)
Living area fraction	18.3896	18.6051	18.9460	19.4043	19.8082	20.0643	20.1264	20.1214	19.9731	19.4665	18.8551	18.3653	(92)
Temperature adjustment	18.3896	18.6051	18.9460	19.4043	19.8082	20.0643	20.1264	20.1214	19.9731	19.4665	18.8551	18.3653	(92)
adjusted MIT	18.3896	18.6051	18.9460	19.4043	19.8082	20.0643	20.1264	20.1214	19.9731	19.4665	18.8551	18.3653	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	541.6417	623.3560	682.3963	717.9556	693.2585	549.8267	379.9067	395.5929	540.6422	571.3815	530.6960	512.1542	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1606.4350	1557.8997	1410.5958	1173.9521	903.7704	601.5565	388.2204	408.7343	649.6743	988.2921	1317.2861	1596.2190	(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	792.2062	628.0133	541.7804	328.3175	156.6208	0.0000	0.0000	0.0000	0.0000	310.1815	566.3448	806.5442	(98)
Space heating												4130.0088	(98)
Space heating per m2												44.6294	(99)

8c. Space cooling requirement

Not applicable

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Calculation Type: New Build (As Built)

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													4421.8510 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	792.2062	628.0133	541.7804	328.3175	156.6208	0.0000	0.0000	0.0000	0.0000	310.1815	566.3448	806.5442	(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)	848.1865	672.3912	580.0647	351.5177	167.6882	0.0000	0.0000	0.0000	0.0000	332.1001	606.3649	863.5377	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508	(64)
Efficiency of water heater (217)m	88.0807	87.8855	87.4991	86.6531	84.8972	80.3000	80.3000	80.3000	80.3000	86.4044	87.6213	88.1551	(216)
Fuel for water heating, kWh/month	238.1471	210.4070	221.6276	198.4917	196.1496	182.6481	174.9908	195.0737	197.2281	208.7167	217.9114	232.2621	(219)
Water heating fuel used												2473.6538	(219)
Annual totals kWh/year													
Space heating fuel - main system												4421.8510	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.7732	(232)
Total delivered energy for all uses												7369.2781	(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	4421.8510	0.2160	955.1198 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2473.6538	0.2160	534.3092 (264)
Space and water heating			1489.4290 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Total CO2, kg/m2/year			1735.3173 (272)
Emissions per m2 for space and water heating			16.0950 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2365 (272b)
Emissions per m2 for pumps and fans			0.4206 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0950 * 1.00) + 2.2365 + 0.4206, rounded to 2 d.p.			18.7500 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					4.7700
Infiltration rate					0.3739 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3739 (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	0.4767	0.4674	0.4580	0.4113	0.4020	0.3552	0.3552	0.3459	0.3739	0.4020	0.4206	0.4393 (22b)
Effective ac	0.6136	0.6092	0.6049	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5965 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			9.0000	411.9300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	14627.6120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							158.0680 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.8637	44.5411	44.2248	42.7395	42.4616	41.1680	41.1680	40.9284	41.6663	42.4616	43.0238	43.6116 (38)
Heat transfer coeff	119.3891	119.0664	118.7502	117.2649	116.9870	115.6933	115.6933	115.4538	116.1916	116.9870	117.5492	118.1369 (39)
Average = Sum(39)m / 12 =												117.2636 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2901	1.2866	1.2832	1.2672	1.2642	1.2502	1.2502	1.2476	1.2556	1.2642	1.2703	1.2766 (40)
HLP (average)												1.2672 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total =	Sum (45)m =	1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.7456	29.5141	30.4559	26.5522	25.4775	21.9851	20.3724	23.3777	23.6569	27.5698	30.0946	32.6808 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	45.3570	43.9198	40.9354	36.8780	34.2439	30.5349	27.3823	31.4216	32.8568	37.0562	41.7981	43.9258 (72)
Total internal gains	374.4947	373.0614	359.9598	338.3751	315.4998	294.2595	280.9829	285.0183	296.5707	318.2975	343.2805	362.9396 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					4.8200	10.6334	0.7100	0.7000	0.7700		17.6526 (74)	
Southeast					0.6800	36.7938	0.7100	0.7000	0.7700		8.6173 (77)	
South					5.7600	46.7521	0.7100	0.7000	0.7700		92.7498 (78)	
Southwest					0.6800	36.7938	0.7100	0.7000	0.7700		8.6173 (79)	
North					3.1500	10.6334	0.7100	0.7000	0.7700		11.5364 (74)	
Solar gains	139.1735	237.0391	328.4484	420.7117	488.7321	494.2176	472.6275	419.6277	359.5848	262.6854	166.5917	119.2271 (83)
Total gains	513.6682	610.1005	688.4082	759.0868	804.2319	788.4771	753.6104	704.6460	656.1555	580.9829	509.8723	482.1666 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.0335	34.1257	34.2166	34.6500	34.7323	35.1207	35.1207	35.1935	34.9700	34.7323	34.5662	34.3942
alpha	3.2689	3.2750	3.2811	3.3100	3.3155	3.3414	3.3414	3.3462	3.3313	3.3155	3.3044	3.2929
util living area	0.9912	0.9838	0.9698	0.9371	0.8686	0.7449	0.6032	0.6518	0.8394	0.9530	0.9852	0.9928 (86)
MIT	18.9495	19.1799	19.5414	20.0172	20.4586	20.7864	20.9241	20.8998	20.6505	20.0784	19.4294	18.9130 (87)
Th 2	19.8486	19.8513	19.8540	19.8666	19.8690	19.8801	19.8801	19.8821	19.8758	19.8690	19.8642	19.8592 (88)
util rest of house	0.9891	0.9801	0.9623	0.9202	0.8297	0.6637	0.4769	0.5295	0.7777	0.9371	0.9812	0.9911 (89)
MIT 2	17.9865	18.2171	18.5766	19.0506	19.4681	19.7579	19.8521	19.8417	19.6518	19.1185	18.4760	17.9579 (90)
Living area fraction									fLA =	Living area / (4) =		0.1961 (91)
MIT	18.1754	18.4059	18.7658	19.2402	19.6624	19.9596	20.0623	20.0492	19.8477	19.3068	18.6630	18.1452 (92)
Temperature adjustment												0.0000
adjusted MIT	18.1754	18.4059	18.7658	19.2402	19.6624	19.9596	20.0623	20.0492	19.8477	19.3068	18.6630	18.1452 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	505.9039	594.0066	656.0538	689.6231	660.4402	528.4481	376.2952	387.3847	509.0844	538.4088	497.2084	476.1704 (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	1656.5658	1608.1012	1456.5704	1212.5413	931.4916	620.0740	400.5682	421.3194	667.8299	1018.5782	1359.2248	1647.4468 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	856.0924	681.4716	595.5844	376.5011	201.6623	0.0000	0.0000	0.0000	0.0000	357.2460	620.6518	871.4296 (98)
Space heating												4560.6392 (98)
Space heating per m2										(98) / (4) =		49.2829 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1087.5172	856.1306	877.4485	0.0000	0.0000	0.0000	0.0000	(100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7454	0.8186	0.7895	0.0000	0.0000	0.0000	0.0000	(101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	810.6657	700.8165	692.7827	0.0000	0.0000	0.0000	0.0000	(102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1022.5957	979.7297	924.3589	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	152.5896	207.5114	172.2927	0.0000	0.0000	0.0000	0.0000	(104)	
Space cooling														
Cooled fraction									fC = cooled area / (4) =			532.3937	(104)	
Intermittency factor (Table 10b)												1.0000	(105)	
	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	38.1474	51.8779	43.0732	0.0000	0.0000	0.0000	0.0000	(107)	
Space cooling													133.0984	(107)
Space cooling per m2													1.4383	(108)
Energy for space heating													49.2829	(99)
Energy for space cooling													1.4383	(108)
Total													50.7212	(109)
Dwelling Fabric Energy Efficiency (DFEE)													50.7	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3854 (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	0.4914	0.4818	0.4721	0.4240	0.4143	0.3661	0.3661	0.3565	0.3854	0.4143	0.4336	0.4529 (22b)
Effective ac	0.6207	0.6160	0.6115	0.5899	0.5858	0.5670	0.5670	0.5635	0.5743	0.5858	0.5940	0.6025 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			1.9600	1.0000	1.9600		(26)
TER Semi-glazed door			1.8900	1.2000	2.2680		(26a)
TER Opening Type (Uw = 1.40)			15.0900	1.3258	20.0057		(27)
Heat Loss Floor			46.7700	0.1300	6.0801		(28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.1800	20.8422		(29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501		(30)
Bay	1.0100		1.0100	0.1300	0.1313		(30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.2374		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3958 (36)
Total fabric heat loss						(33) + (36) =	68.6332 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	45.3826	45.0398	44.7039	43.1258	42.8305	41.4560	41.4560	41.2015	41.9855	42.8305	43.4278	44.0523 (38)
Heat transfer coeff	114.0158	113.6730	113.3370	111.7590	111.4637	110.0892	110.0892	109.8347	110.6187	111.4637	112.0610	112.6854 (39)
Average = Sum(39)m / 12 =												111.7575 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2321	1.2284	1.2247	1.2077	1.2045	1.1896	1.1896	1.1869	1.1954	1.2045	1.2109	1.2177 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy content (annual)	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Distribution loss	Total = Sum(45)m = 1531.6825 (45)											
	$(46)m = 0.15 \times (45)m$											
	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:												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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 (56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	33.7456	29.5141	30.4559	26.5522	25.4775	21.9851	20.3724	23.3777	23.6569	27.5698	30.0946	32.6808 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	45.3570	43.9198	40.9354	36.8780	34.2439	30.5349	27.3823	31.4216	32.8568	37.0562	41.7981	43.9258 (72)
Total internal gains	374.4947	373.0614	359.9598	338.3751	315.4998	294.2595	280.9829	285.0183	296.5707	318.2975	343.2805	362.9396 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.9700	10.6334	0.6300	0.7000	0.7700	25.9001 (74)
Southeast	0.6800	36.7938	0.6300	0.7000	0.7700	7.6464 (77)
South	5.7600	46.7521	0.6300	0.7000	0.7700	82.2991 (78)
Southwest	0.6800	36.7938	0.6300	0.7000	0.7700	7.6464 (79)

Solar gains	123.4920	210.3304	291.4401	373.3076	433.6637	438.5311	419.3737	372.3457	319.0682	233.0870	147.8208	105.7930 (83)
Total gains	497.9867	583.3919	651.3999	711.6827	749.1635	732.7906	700.3566	657.3640	615.6389	551.3845	491.1014	468.7326 (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	56.3640	56.5340	56.7016	57.5022	57.6545	58.3744	58.3744	58.5096	58.0950	57.6545	57.3472	57.0294
alpha	4.7576	4.7689	4.7801	4.8335	4.8436	4.8916	4.8916	4.9006	4.8730	4.8436	4.8231	4.8020
util living area	0.9987	0.9971	0.9927	0.9782	0.9323	0.8136	0.6520	0.7065	0.9054	0.9855	0.9974	0.9991 (86)
MIT	19.5934	19.7508	20.0020	20.3411	20.6602	20.8908	20.9720	20.9588	20.7928	20.3811	19.9282	19.5716 (87)
Th 2	19.8944	19.8974	19.9003	19.9139	19.9164	19.9283	19.9283	19.9305	19.9237	19.9164	19.9113	19.9059 (88)
util rest of house	0.9983	0.9960	0.9899	0.9689	0.9004	0.7269	0.5125	0.5708	0.8480	0.9776	0.9963	0.9988 (89)
MIT 2	18.6137	18.7730	19.0253	19.3702	19.6740	19.8739	19.9207	19.9179	19.8008	19.4146	18.9614	18.6009 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.8058	18.9648	19.2169	19.5606	19.8674	20.0734	20.1269	20.1220	19.9953	19.6041	19.1510	18.7913 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8058	18.9648	19.2169	19.5606	19.8674	20.0734	20.1269	20.1220	19.9953	19.6041	19.1510	18.7913 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9977	0.9948	0.9876	0.9649	0.8987	0.7403	0.5402	0.5975	0.8527	0.9745	0.9951	0.9983 (94)
Useful gains	496.8333	580.3571	643.3012	686.6994	673.2404	542.4667	378.3079	392.7629	524.9565	537.3032	488.7178	467.9231 (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	1653.8928	1598.7859	1441.2904	1191.4146	910.3686	602.5598	388.2760	408.8093	652.1320	1003.6334	1350.4447	1644.2284 (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	860.8523	684.3841	593.7040	363.3950	176.4234	0.0000	0.0000	0.0000	0.0000	346.9497	620.4433	875.1711 (98)
Space heating												4521.3229 (98)
Space heating per m2										(98) / (4) =		48.8580 (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	1034.8387	814.6603	834.7437	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7965	0.8756	0.8468	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	824.2366	713.2926	706.8807	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	957.5076	917.4850	869.0943	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	95.9551	151.9192	120.6869	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												368.5612 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)	
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	23.9888	37.9798	30.1717	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												92.1403 (107)
Space cooling per m2												0.9957 (108)
Energy for space heating												48.8580 (99)
Energy for space cooling												0.9957 (108)
Total												49.8537 (109)
Target Fabric Energy Efficiency (TFEE)												57.3 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.7700
Infiltration rate					0.4190 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.4190 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate												
	0.4400	0.4086	0.4190	0.3981	0.3981	0.3876	0.3771	0.3667	0.3562	0.3876	0.3667	0.3876 (22b)
Effective ac	0.5968	0.5835	0.5878	0.5792	0.5792	0.5751	0.5711	0.5672	0.5634	0.5751	0.5672	0.5751 (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			1.9600	0.9000	1.7640			(26)					
Window (Uw = 1.40)			11.9400	1.3258	15.8295			(27)					
French (Uw = 1.40)			3.1500	1.3258	4.1761			(27)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300	(30)					
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900	(30)					
Total net area of external elements Aum(A, m2)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418			(33)					
GF Masonry			41.2600			39.0000	1609.1400	(32c)					
GF Timber			34.3700			9.0000	309.3300	(32c)					
1F Timber			81.4300			9.0000	732.8700	(32c)					
1F Metal			34.9000			20.0000	698.0000	(32c)					
Internal Floor			45.7700			18.0000	823.8600	(32d)					
Internal Floor 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.6326	42.6577	42.9746	42.3488	42.3488	42.0479	41.7550	41.4701	41.1933	42.0479	41.4701	42.0479	(38)
Heat transfer coeff													
	118.1580	117.1831	117.5000	116.8741	116.8741	116.5732	116.2804	115.9955	115.7187	116.5732	115.9955	116.5732	(39)
Average = Sum(39)m / 12 =												116.6916	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2768	1.2663	1.2697	1.2630	1.2630	1.2597	1.2565	1.2535	1.2505	1.2597	1.2535	1.2597	(40)
HLP (average)												1.2610	(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													2.6589 (42)
Average daily hot water use (litres/day)													97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total =	Sum (45)m =	1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
												1778 (64)
												1777.7885 (64)

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

Metabolic gains (Table 5), Watts												
(66)m	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North				4.8200	13.4839		0.7100	0.7000	0.7700		22.3847 (74)	
Southeast				0.6800	45.1778		0.7100	0.7000	0.7700		10.5809 (77)	
South				5.7600	56.7559		0.7100	0.7000	0.7700		112.5960 (78)	
Southwest				0.6800	45.1778		0.7100	0.7000	0.7700		10.5809 (79)	
North				3.1500	13.4839		0.7100	0.7000	0.7700		14.6290 (74)	

Solar gains	170.7716	247.9660	348.4482	453.6409	504.7966	556.1296	527.0252	476.6256	404.4475	296.9855	203.8106	143.7897 (83)
Total gains	778.7474	851.1481	928.0705	996.7348	1010.3978	1028.2895	979.7602	938.2426	887.1967	816.4854	764.1071	735.0408 (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)												
tau	35.3565	35.6506	35.5545	35.7449	35.7449	35.8371	35.9274	36.0156	36.1018	35.8371	36.0156	35.8371
alpha	3.3571	3.3767	3.3703	3.3830	3.3830	3.3891	3.3952	3.4010	3.4068	3.3891	3.4010	3.3891
util living area	0.9699	0.9588	0.9310	0.8713	0.7653	0.5852	0.4440	0.4604	0.6921	0.8760	0.9496	0.9737 (86)
MIT	19.4406	19.6046	19.9364	20.3512	20.6996	20.9143	20.9748	20.9721	20.8427	20.4487	19.9144	19.4307 (87)
Th 2	19.8590	19.8673	19.8646	19.8700	19.8700	19.8725	19.8750	19.8775	19.8798	19.8725	19.8775	19.8725 (88)
util rest of house	0.9633	0.9498	0.9154	0.8408	0.7068	0.4898	0.3242	0.3374	0.6055	0.8394	0.9365	0.9678 (89)
MIT 2	17.8331	18.0733	18.5440	19.1228	19.5759	19.8139	19.8650	19.8662	19.7552	19.2681	18.5282	17.8282 (90)
Living area fraction	18.1484	18.3737	18.8171	19.3637	19.7963	20.0297	20.0827	20.0831	19.9685	19.4996	18.8001	18.1425 (91)
MIT	18.1484	18.3737	18.8171	19.3637	19.7963	20.0297	20.0827	20.0831	19.9685	19.4996	18.8001	18.1425 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9984	18.2237	18.6671	19.2137	19.6463	19.8797	19.9327	19.9331	19.8185	19.3496	18.6501	17.9925 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9479	0.9320	0.8940	0.8193	0.6936	0.4905	0.3306	0.3438	0.6002	0.8184	0.9172	0.9537 (94)
Ext temp.	738.1423	793.2309	829.6822	816.5847	700.8549	504.3757	323.9365	322.5417	532.5292	668.2045	700.8374	700.9760 (95)
Heat loss rate W	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Month fracti	1547.6813	1514.4330	1370.8860	1135.2791	835.2180	533.8719	329.3819	328.6258	592.3093	926.7148	1246.9610	1514.5805 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
	602.2970	484.6478	402.6556	229.4600	99.9662	0.0000	0.0000	0.0000	0.0000	192.3317	393.2089	605.3218 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3009.8891 (98)
RHI space heating demand	3010 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.7700
Infiltration rate					0.4190 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4190 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.5343	0.5238	0.5133	0.4610	0.4505	0.3981	0.3981	0.3876	0.4190	0.4505	0.4714	0.4924 (22b)
	0.6427	0.6372	0.6318	0.6062	0.6015	0.5792	0.5792	0.5751	0.5878	0.6015	0.6111	0.6212 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	46.9906	46.5854	46.1882	44.3227	43.9736	42.3488	42.3488	42.0479	42.9746	43.9736	44.6797	45.4179 (38)
Heat transfer coeff	121.5160	121.1108	120.7136	118.8480	118.4990	116.8741	116.8741	116.5732	117.5000	118.4990	119.2051	119.9433 (39)
Average = Sum(39)m / 12 =												118.8464 (39)
HLP	1.3131	1.3087	1.3044	1.2843	1.2805	1.2630	1.2630	1.2597	1.2697	1.2805	1.2881	1.2961 (40)
HLP (average)												1.2843 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
										Total per year (kWh/year) = Sum (64)m =		1777.7885 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (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
										</			

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	34.3794	34.4945	34.6080	35.1512	35.2547	35.7449	35.7449	35.8371	35.5545	35.2547	35.0459	34.8302
alpha	3.2920	3.2996	3.3072	3.3434	3.3503	3.3830	3.3830	3.3891	3.3703	3.3503	3.3364	3.3220
util living area	0.9761	0.9636	0.9416	0.8950	0.8080	0.6650	0.5191	0.5586	0.7562	0.9076	0.9630	0.9795 (86)
MIT	19.2481	19.4618	19.7910	20.2191	20.5944	20.8563	20.9538	20.9400	20.7634	20.2903	19.7026	19.2150 (87)
Th 2	19.8306	19.8340	19.8374	19.8532	19.8561	19.8700	19.8700	19.8725	19.8646	19.8561	19.8501	19.8439 (88)
util rest of house	0.9709	0.9557	0.9283	0.8696	0.7591	0.5789	0.4006	0.4410	0.6811	0.8800	0.9536	0.9750 (89)
MIT 2	17.5373	17.8469	18.3202	18.9317	19.4349	19.7570	19.8470	19.8401	19.6580	19.0434	18.2084	17.4979 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8729	18.1636	18.6087	19.1842	19.6623	19.9726	20.0641	20.0558	19.8748	19.2880	18.5015	17.8346 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.7229	18.0136	18.4587	19.0342	19.5123	19.8226	19.9141	19.9058	19.7248	19.1380	18.3515	17.6846 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9570	0.9384	0.9073	0.8471	0.7419	0.5749	0.4055	0.4447	0.6705	0.8578	0.9362	0.9625 (94)
Useful gains	715.0394	788.4543	823.9270	816.4305	737.6799	555.5542	375.2308	391.9022	564.7437	670.9287	680.5024	683.8064 (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	1631.0940	1588.2033	1443.5746	1204.4274	925.7538	610.3923	387.3277	408.6878	660.9133	1011.7402	1341.2319	1617.3924 (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	681.5446	537.4314	461.0179	279.3577	139.9270	0.0000	0.0000	0.0000	0.0000	253.5637	475.7253	694.5879 (98)
Space heating												3523.1555 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2

(98) / (4) = 38.0717 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3914.6172 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	681.5446	537.4314	461.0179	279.3577	139.9270	0.0000	0.0000	0.0000	0.0000	253.5637	475.7253	694.5879	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	757.2718	597.1460	512.2421	310.3975	155.4744	0.0000	0.0000	0.0000	0.0000	281.7375	528.5836	771.7644	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.2904	89.2288	89.1089	88.8436	88.3145	86.7000	86.7000	86.7000	86.7000	88.7411	89.1384	86.7000	(216)
Fuel for water heating, kWh/month	201.4205	176.9383	184.3783	163.4003	159.3502	142.5096	134.4811	150.8755	151.6607	169.7723	181.6696	195.7275	(219)
Water heating fuel used												2012.1840	(219)
Annual totals kWh/year													
Space heating fuel - main system												3914.6172	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1080 * 1.00) =										-699.5320		-699.5320	(233)
Total delivered energy for all uses												5701.0425	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3914.6172	3.4800	136.2287 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2012.1840	3.4800	70.0240 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	398.7732	13.1900	52.5982 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-699.5320	13.1900	-92.2683 (252)
Total energy cost			296.4751 (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] =	0.9053 (257)
SAP value		87.3706
SAP rating (Section 12)		87 (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	3914.6172	0.2160	845.5573 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2012.1840	0.2160	434.6317 (264)
Space and water heating			1280.1891 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-699.5320	0.5190	-363.0571 (269)
Total kg/year			1163.0203 (272)
CO2 emissions per m2			12.5700 (273)
EI value			88.6691
EI rating			89 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency
Main heating environmental impact
Water heating energy efficiency
Water heating environmental impact

$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
 $0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
 $3.48 / 0.8823 = 3.944$, stars = 4
 $0.216 / 0.8823 = 0.2448$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	+	secondary heating	+	other	=	total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							4 * 10 =	40.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
								Air changes per hour				
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						40.0000 / (5) =	0.1805 (8)				
Pressure test							Yes					
Measured/design AP50								4.7700				
Infiltration rate								0.4190 (18)				
Number of sides sheltered								0 (19)				
Shelter factor							(20) = 1 - [0.075 x (19)] =	1.0000 (20)				
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.4190 (21)				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.4400	0.4086	0.4190	0.3981	0.3981	0.3876	0.3771	0.3667	0.3562	0.3876	0.3667	0.3876 (22b)
Effective ac	0.5968	0.5835	0.5878	0.5792	0.5792	0.5751	0.5711	0.5672	0.5634	0.5751	0.5672	0.5751 (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			1.9600	0.9000	1.7640			(26)					
Window (Uw = 1.40)			11.9400	1.3258	15.8295			(27)					
French (Uw = 1.40)			3.1500	1.3258	4.1761			(27)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300	(30)					
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900	(30)					
Total net area of external elements Aum(A, m2)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418			(33)					
GF Masonry			41.2600			39.0000	1609.1400	(32c)					
GF Timber			34.3700			9.0000	309.3300	(32c)					
1F Timber			81.4300			9.0000	732.8700	(32c)					
1F Metal			34.9000			20.0000	698.0000	(32c)					
Internal Floor			45.7700			18.0000	823.8600	(32d)					
Internal Floor 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.6326	42.6577	42.9746	42.3488	42.3488	42.0479	41.7550	41.4701	41.1933	42.0479	41.4701	42.0479	(38)
Heat transfer coeff	118.1580	117.1831	117.5000	116.8741	116.8741	116.5732	116.2804	115.9955	115.7187	116.5732	115.9955	116.5732	(39)
Average = Sum(39)m / 12 =												116.6916	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2768	1.2663	1.2697	1.2630	1.2630	1.2597	1.2565	1.2535	1.2505	1.2597	1.2535	1.2597	(40)
HLP (average)												1.2610	(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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =								130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Output from w/h	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
Total per year (kWh/year) = Sum (64)m =								41.7783	42.0569	48.3680	52.1681	1777.7885 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
North				4.8200	13.4839	0.7100	0.7000	0.7700		22.3847 (74)		
Southeast				0.6800	45.1778	0.7100	0.7000	0.7700		10.5809 (77)		
South				5.7600	56.7559	0.7100	0.7000	0.7700		112.5960 (78)		
Southwest				0.6800	45.1778	0.7100	0.7000	0.7700		10.5809 (79)		
North				3.1500	13.4839	0.7100	0.7000	0.7700		14.6290 (74)		
Solar gains	170.7716	247.9660	348.4482	453.6409	504.7966	556.1296	527.0252	476.6256	404.4475	296.9855	203.8106	143.7897 (83)
Total gains	778.7474	851.1481	928.0705	996.7348	1010.3978	1028.2895	979.7602	938.2426	887.1967	816.4854	764.1071	735.0408 (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	35.3565	35.6506	35.5545	35.7449	35.7449	35.8371	35.9274	36.0156	36.1018	35.8371	36.0156	35.8371
alpha	3.3571	3.3767	3.3703	3.3830	3.3830	3.3891	3.3952	3.4010	3.4068	3.3891	3.4010	3.3891
util living area	0.9699	0.9588	0.9310	0.8713	0.7653	0.5852	0.4440	0.4604	0.6921	0.8760	0.9496	0.9737 (86)
MIT	19.4406	19.6046	19.9364	20.3512	20.6996	20.9143	20.9748	20.9721	20.8427	20.4487	19.9144	19.4307 (87)
Th 2	19.8590	19.8673	19.8646	19.8700	19.8700	19.8725	19.8750	19.8775	19.8798	19.8725	19.8775	19.8725 (88)
util rest of house	0.9633	0.9498	0.9154	0.8408	0.7068	0.4898	0.3242	0.3374	0.6055	0.8394	0.9365	0.9678 (89)
MIT 2	17.8331	18.0733	18.5440	19.1228	19.5759	19.8139	19.8650	19.8662	19.7552	19.2681	18.5282	17.8282 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.1484	18.3737	18.8171	19.3637	19.7963	20.0297	20.0827	20.0831	19.9685	19.4996	18.8001	18.1425 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9984	18.2237	18.6671	19.2137	19.6463	19.8797	19.9327	19.9331	19.8185	19.3496	18.6501	17.9925 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9479	0.9320	0.8940	0.8193	0.6936	0.4905	0.3306	0.3438	0.6002	0.8184	0.9172	0.9537 (94)
Ext temp.	738.1423	793.2309	829.6822	816.5847	700.8549	504.3757	323.9365	322.5417	532.5292	668.2045	700.8374	700.9760 (95)
Heat loss rate W	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Month fracti	1547.6813	1514.4330	1370.8860	1135.2791	835.2180	533.8719	329.3819	328.6258	592.3093	926.7148	1246.9610	1514.5805 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	602.2970	484.6478	402.6556	229.4600	99.9662	0.0000	0.0000	0.0000	0.0000	192.3317	393.2089	605.3218 (98)
												3009.8891 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Space heating per m2 (98) / (4) = 32.5253 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3344.3212 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	602.2970	484.6478	402.6556	229.4600	99.9662	0.0000	0.0000	0.0000	0.0000	192.3317	393.2089	605.3218	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	669.2189	538.4976	447.3951	254.9555	111.0736	0.0000	0.0000	0.0000	0.0000	213.7018	436.8988	672.5798	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.2191	89.1661	89.0181	88.6919	88.0407	86.7000	86.7000	86.7000	86.7000	88.5200	89.0117	86.7000	(216)
Fuel for water heating, kWh/month	201.5814	177.0629	184.5663	163.6800	159.8457	142.5096	134.4811	150.8755	151.6607	170.1963	181.9281	195.8976	(219)
Water heating fuel used												2014.2851	(219)
Annual totals kWh/year													
Space heating fuel - main system												3344.3212	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1208 * 1.00) =										-782.8819		-782.8819	(233)
Total delivered energy for all uses												5049.4976	(238)

10a. Fuel costs - using BEDF prices (445)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3344.3212	3.9300	131.4318	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2014.2851	3.9300	79.1614	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Energy for lighting	398.7732	17.5600	70.0246	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-782.8819	17.5600	-137.4741	(252)
Total energy cost			244.3137	(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	3344.3212	0.2160	722.3734	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.2851	0.2160	435.0856	(264)
Space and water heating			1157.4590	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.7732	0.5190	206.9633	(268)
Energy saving/generation technologies				
PV Unit	-782.8819	0.5190	-406.3157	(269)
Total kg/year			997.0316	(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	3344.3212	1.2200	4080.0719	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.2851	1.2200	2457.4278	(264)
Space and water heating			6537.4996	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	398.7732	3.0700	1224.2338	(268)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Energy saving/generation technologies			
PV Unit	-782.8819	3.0700	-2403.4473 (269)
Primary energy kWh/year			5588.5361 (272)
Primary energy kWh/m2/year			60.3905 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 87
Current environmental impact rating:	B 89

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 31	-195 kg (19.5%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£31 2.11 kg/m²	B 89	B 90
Total Savings	£31 2.11 kg/m²		

Potential energy efficiency rating:	B 89
Potential environmental impact rating:	B 90

Fuel prices for cost data on this page from database revision number 445 TEST (30 Jul 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£83	£92	-£9
Mains gas	£299	£258	£40
Space heating	£233	£233	£0
Water heating	£79	£48	£31
Lighting	£70	£70	£0
Generated (PV)	-£137	-£137	£0
Total cost of fuels	£245	£213	£31
Total cost of uses	£245	£214	£31
Delivered energy	55 kWh/m²	44 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	2 kg/m²
Primary energy	60 kWh/m²	49 kWh/m²	12 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.7700
Infiltration rate					0.4190 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.4190 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.5343	0.5238	0.5133	0.4610	0.4505	0.3981	0.3981	0.3876	0.4190	0.4505	0.4714	0.4924 (22b)
	0.6427	0.6372	0.6318	0.6062	0.6015	0.5792	0.5792	0.5751	0.5878	0.6015	0.6111	0.6212 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	46.9906	46.5854	46.1882	44.3227	43.9736	42.3488	42.3488	42.0479	42.9746	43.9736	44.6797	45.4179 (38)
Heat transfer coeff	121.5160	121.1108	120.7136	118.8480	118.4990	116.8741	116.8741	116.5732	117.5000	118.4990	119.2051	119.9433 (39)
Average = Sum(39)m / 12 =												118.8464 (39)
HLP	1.3131	1.3087	1.3044	1.2843	1.2805	1.2630	1.2630	1.2597	1.2697	1.2805	1.2881	1.2961 (40)
HLP (average)												1.2843 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1841 (H8)
Utilisation factor												0.5703 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.3492 (H14)
Volume ratio Veff/V												0.7704 (H15)
Solar storage volume factor												0.9478 (H16)
Solar input												-861.9358 (H17)
Solar input	-24.9944	-41.7085	-71.0344	-95.2000	-117.6116	-115.6310	-114.1028	-99.6922	-78.0790	-53.3188	-29.6470	-20.9161 (63)
Solar input (sum of months) = Sum (63)m =												-861.9358 (63)
Output from w/h	154.8547	116.1715	93.2631	49.9708	23.1177	7.9249	2.4922	31.1168	53.4109	97.3390	132.2903	153.9008 (64)
Total per year (kWh/year) = Sum (64)m =												915.8527 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958	(72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North					4.8200	10.6334	0.7100	0.7000	0.7700	17.6526 (74)			
Southeast					0.6800	36.7938	0.7100	0.7000	0.7700	8.6173 (77)			
South					5.7600	46.7521	0.7100	0.7000	0.7700	92.7498 (78)			
Southwest					0.6800	36.7938	0.7100	0.7000	0.7700	8.6173 (79)			
North					3.1500	10.6334	0.7100	0.7000	0.7700	11.5364 (74)			
Solar gains	139.1735	237.0391	328.4484	420.7117	488.7321	494.2176	472.6275	419.6277	359.5848	262.6854	166.5917	119.2271	(83)
Total gains	747.1493	840.2212	908.0707	963.8057	994.3333	966.3775	925.3624	881.2447	842.3341	782.1853	726.8883	710.4782	(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	34.3794	34.4945	34.6080	35.1512	35.2547	35.7449	35.7449	35.8371	35.5545	35.2547	35.0459	34.8302	
alpha	3.2920	3.2996	3.3072	3.3434	3.3503	3.3830	3.3830	3.3891	3.3703	3.3503	3.3364	3.3220	
util living area	0.9761	0.9636	0.9416	0.8950	0.8080	0.6650	0.5191	0.5586	0.7562	0.9076	0.9630	0.9795	(86)
MIT	19.2481	19.4618	19.7910	20.2191	20.5944	20.8563	20.9538	20.9400	20.7634	20.2903	19.7026	19.2150	(87)
Th 2	19.8306	19.8340	19.8374	19.8532	19.8561	19.8700	19.8700	19.8725	19.8646	19.8561	19.8501	19.8439	(88)
util rest of house	0.9709	0.9557	0.9283	0.8696	0.7591	0.5789	0.4006	0.4410	0.6811	0.8800	0.9536	0.9750	(89)
MIT 2	17.5373	17.8469	18.3202	18.9317	19.4349	19.7570	19.8470	19.8401	19.6580	19.0434	18.2084	17.4979	(90)
Living area fraction									fLA = Living area / (4) =			0.1961	(91)
MIT	17.8729	18.1636	18.6087	19.1842	19.6623	19.9726	20.0641	20.0558	19.8748	19.2880	18.5015	17.8346	(92)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment													-0.1500
adjusted MIT	17.7229	18.0136	18.4587	19.0342	19.5123	19.8226	19.9141	19.9058	19.7248	19.1380	18.3515		17.6846 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9570	0.9384	0.9073	0.8471	0.7419	0.5749	0.4055	0.4447	0.6705	0.8578	0.9362	0.9625	(94)
Useful gains	715.0394	788.4543	823.9270	816.4305	737.6799	555.5542	375.2308	391.9022	564.7437	670.9287	680.5024	683.8064	(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													
	1631.0940	1588.2033	1443.5746	1204.4274	925.7538	610.3923	387.3277	408.6878	660.9133	1011.7402	1341.2319	1617.3924	(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													
	681.5446	537.4314	461.0179	279.3577	139.9270	0.0000	0.0000	0.0000	0.0000	253.5637	475.7253	694.5879	(98)
Space heating													3523.1555 (98)
Space heating per m2											(98) / (4) =	38.0717	(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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3914.6172 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	681.5446	537.4314	461.0179	279.3577	139.9270	0.0000	0.0000	0.0000	0.0000	253.5637	475.7253	694.5879	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	757.2718	597.1460	512.2421	310.3975	155.4744	0.0000	0.0000	0.0000	0.0000	281.7375	528.5836	771.7644	(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	154.8547	116.1715	93.2631	49.9708	23.1177	7.9249	2.4922	31.1168	53.4109	97.3390	132.2903	153.9008	(64)
Efficiency of water heater	89.3702	89.3952	89.4273	89.4832	89.5169	86.7000	86.7000	86.7000	86.7000	89.0597	89.2608	86.7000	(216)
(217)m													89.3829 (217)
Fuel for water heating, kWh/month	173.2733	129.9527	104.2893	55.8437	25.8249	9.1406	2.8745	35.8902	61.6042	109.2964	148.2066	172.1814	(219)
Water heating fuel used												1028.3780	(219)
Annual totals kWh/year													
Space heating fuel - main system												3914.6172	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1080 * 1.00) =										-699.5320		-699.5320	(233)
Total delivered energy for all uses												4767.2365	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3914.6172	3.4800	136.2287	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1028.3780	3.4800	35.7876	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	398.7732	13.1900	52.5982	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-699.5320	13.1900	-92.2683	(252)
Total energy cost			268.8337	(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] =	0.8209 (257)
SAP value			88.5481
SAP rating (Section 12)			89 (258)
SAP band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3914.6172	0.2160	845.5573	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1028.3780	0.2160	222.1296	(264)
Space and water heating			1067.6870	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	398.7732	0.5190	206.9633	(268)
Energy saving/generation technologies				
PV Unit	-699.5320	0.5190	-363.0571	(269)
Total kg/year			976.4682	(272)
CO2 emissions per m2			10.5500	(273)
EI value			90.4866	
EI rating			90	(274)
EI band			B	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.7700
Infiltration rate					0.4190 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.4190 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.4400	0.4086	0.4190	0.3981	0.3981	0.3876	0.3771	0.3667	0.3562	0.3876	0.3667	0.3876 (22b)
Effective ac	0.5968	0.5835	0.5878	0.5792	0.5792	0.5751	0.5711	0.5672	0.5634	0.5751	0.5672	0.5751 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.6326	42.6577	42.9746	42.3488	42.3488	42.0479	41.7550	41.4701	41.1933	42.0479	41.4701	42.0479 (38)
Heat transfer coeff	118.1580	117.1831	117.5000	116.8741	116.8741	116.5732	116.2804	115.9955	115.7187	116.5732	115.9955	116.5732 (39)
Average = Sum(39)m / 12 =												116.6916 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2768	1.2663	1.2697	1.2630	1.2630	1.2597	1.2565	1.2535	1.2505	1.2597	1.2535	1.2597 (40)
HLP (average)												1.2610 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3251 (H8)
Utilisation factor												0.5298 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.3492 (H14)
Volume ratio Veff/V												0.7704 (H15)
Solar storage volume factor												0.9478 (H16)
Solar input												-896.2419 (H17)
Solar input	-29.2376	-41.5740	-71.4557	-96.4103	-113.2396	-120.9578	-118.4140	-105.9842	-82.9783	-57.3683	-34.5804	-24.0418 (63)
Solar input (sum of months) = Sum (63)m =												-896.2419 (63)
Output from w/h	150.6116	116.3060	92.8418	48.7605	27.4897	2.5980	0.0000	24.8249	48.5116	93.2895	127.3570	150.7750 (64)
Total per year (kWh/year) = Sum (64)m =												883.3655 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958	(72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					4.8200	13.4839	0.7100	0.7000	0.7700		22.3847 (74)	
Southeast					0.6800	45.1778	0.7100	0.7000	0.7700		10.5809 (77)	
South					5.7600	56.7559	0.7100	0.7000	0.7700		112.5960 (78)	
Southwest					0.6800	45.1778	0.7100	0.7000	0.7700		10.5809 (79)	
North					3.1500	13.4839	0.7100	0.7000	0.7700		14.6290 (74)	
Solar gains	170.7716	247.9660	348.4482	453.6409	504.7966	556.1296	527.0252	476.6256	404.4475	296.9855	203.8106	143.7897 (83)
Total gains	778.7474	851.1481	928.0705	996.7348	1010.3978	1028.2895	979.7602	938.2426	887.1967	816.4854	764.1071	735.0408 (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	35.3565	35.6506	35.5545	35.7449	35.7449	35.8371	35.9274	36.0156	36.1018	35.8371	36.0156	35.8371	
alpha	3.3571	3.3767	3.3703	3.3830	3.3830	3.3891	3.3952	3.4010	3.4068	3.3891	3.4010	3.3891	
util living area	0.9699	0.9588	0.9310	0.8713	0.7653	0.5852	0.4440	0.4604	0.6921	0.8760	0.9496	0.9737	(86)
MIT	19.4406	19.6046	19.9364	20.3512	20.6996	20.9143	20.9748	20.9721	20.8427	20.4487	19.9144	19.4307	(87)
Th 2	19.8590	19.8673	19.8646	19.8700	19.8700	19.8725	19.8750	19.8775	19.8798	19.8725	19.8775	19.8725	(88)
util rest of house	0.9633	0.9498	0.9154	0.8408	0.7068	0.4898	0.3242	0.3374	0.6055	0.8394	0.9365	0.9678	(89)
MIT 2	17.8331	18.0733	18.5440	19.1228	19.5759	19.8139	19.8650	19.8662	19.7552	19.2681	18.5282	17.8282	(90)
Living area fraction									fLA = Living area / (4) =			0.1961	(91)
MIT	18.1484	18.3737	18.8171	19.3637	19.7963	20.0297	20.0827	20.0831	19.9685	19.4996	18.8001	18.1425	(92)

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

Temperature adjustment													-0.1500
adjusted MIT	17.9984	18.2237	18.6671	19.2137	19.6463	19.8797	19.9327	19.9331	19.8185	19.3496	18.6501		17.9925 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9479	0.9320	0.8940	0.8193	0.6936	0.4905	0.3306	0.3438	0.6002	0.8184	0.9172	0.9537	(94)
Useful gains	738.1423	793.2309	829.6822	816.5847	700.8549	504.3757	323.9365	322.5417	532.5292	668.2045	700.8374	700.9760	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1547.6813	1514.4330	1370.8860	1135.2791	835.2180	533.8719	329.3819	328.6258	592.3093	926.7148	1246.9610	1514.5805	(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	602.2970	484.6478	402.6556	229.4600	99.9662	0.0000	0.0000	0.0000	0.0000	192.3317	393.2089	605.3218	(98)
Space heating												3009.8891	(98)
Space heating per m2											(98) / (4) =	32.5253	(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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3344.3212 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	602.2970	484.6478	402.6556	229.4600	99.9662	0.0000	0.0000	0.0000	0.0000	192.3317	393.2089	605.3218	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	669.2189	538.4976	447.3951	254.9555	111.0736	0.0000	0.0000	0.0000	0.0000	213.7018	436.8988	672.5798	(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	150.6116	116.3060	92.8418	48.7605	27.4897	2.5980	0.0000	24.8249	48.5116	93.2895	127.3570	150.7750	(64)
Efficiency of water heater (217)m	89.3199	89.3419	89.3627	89.4036	89.2672	86.7000	86.7000	86.7000	86.7000	88.8949	89.1697	86.7000	(216)
Fuel for water heating, kWh/month	168.6204	130.1809	103.8932	54.5398	30.7948	2.9966	0.0000	28.6331	55.9534	104.9436	142.8255	168.7994	(219)
Water heating fuel used												992.1805	(219)
Annual totals kWh/year													
Space heating fuel - main system												3344.3212	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1208 * 1.00) =										-782.8819		-782.8819	(233)
Total delivered energy for all uses												4077.3931	(238)

10a. Fuel costs - using BEDF prices (445)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3344.3212	3.9300	131.4318	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	992.1805	3.9300	38.9927	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Pump for solar water heating	50.0000	17.5600	8.7800	(249)
Energy for lighting	398.7732	17.5600	70.0246	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-782.8819	17.5600	-137.4741	(252)
Total energy cost			212.9250	(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	3344.3212	0.2160	722.3734	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	992.1805	0.2160	214.3110	(264)
Space and water heating			936.6844	(265)

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Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-782.8819	0.5190	-406.3157 (269)
Total kg/year			802.2070 (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	3344.3212	1.2200	4080.0719 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	992.1805	1.2200	1210.4602 (264)
Space and water heating			5290.5321 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	398.7732	3.0700	1224.2338 (268)
Energy saving/generation technologies			
PV Unit	-782.8819	3.0700	-2403.4473 (269)
Primary energy kWh/year			4495.0686 (272)
Primary energy kWh/m2/year			48.5743 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	162.5 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	292.44 (P1)
Transmission heat loss coefficient	74.53 (37)
Summer heat loss coefficient	366.97 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.8200	87.1704	0.7100	0.7000	0.9000	169.1444
South East	0.6800	127.3119	0.7100	0.7000	0.9000	34.8513
South	5.7600	118.5567	0.7100	0.7000	0.9000	274.9096
South West	0.6800	127.3119	0.7100	0.7000	0.9000	34.8513
North	3.1500	87.1704	0.7100	0.7000	0.9000	110.5404

total: 624.2971

	Jun	Jul	Aug	
Solar gains	670	624	563	(P3)
Internal gains	469	450	459	
Total summer gains	1139	1074	1021	(P5)

Summer gain/loss ratio	3.10	2.93	2.78	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 162.5)	0.86	0.86	0.86	
Threshold temperature	19.37	21.09	20.95	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight