

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-158				Issued on Date	12/11/2019
Assessment Reference	As Built	Prop Type Ref	P306i - Semi (Op)			
Property	73, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	88 B	DER	13.39	TER	17.44	
Environmental	89 B	% DER<TER	23.24			
CO ₂ Emissions (t/year)	0.93	DFEE	44.60	TFEE	50.87	
General Requirements Compliance	Pass	% DFEE<TFEE	12.32			
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

Semi-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) 17.44 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 13.39 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.9 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)44.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.13 (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:	4.50 (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 East:	7.97 m ² , No overhang
Windows facing South West:	0.68 m ² , No overhang
Windows facing West:	5.76 m ² , No overhang
Windows facing North West:	0.68 m ² , No overhang
Air change rate:	4.00 ach
Blinds/curtains:	None

10 Key features

Party wall U-value	0.00 W/m ² K
Door U-value	0.90 W/m ² K
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	secondary	other	total	m3 per hour			
										heating	heating						
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																	4.5000
Infiltration rate																	0.4055 (18)
Number of sides sheltered																	1 (19)
Shelter factor										(20) = 1 - [0.075 x (19)] =							0.9250 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.3751 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)				
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)				
	0.4783	0.4689	0.4595	0.4126	0.4033	0.3564	0.3564	0.3470	0.3751	0.4033	0.4220	0.4408	(22b)				
Effective ac	0.6144	0.6099	0.6056	0.5851	0.5813	0.5635	0.5635	0.5602	0.5704	0.5813	0.5891	0.5971	(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)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(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)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
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			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 44.9180	Feb 44.5933	Mar 44.2750	Apr 42.7800	May 42.5003	Jun 41.1981	Jul 41.1981	Aug 40.9570	Sep 41.6997	Oct 42.5003	Nov 43.0661	Dec 43.6577	(38)
Heat transfer coeff	107.9311	107.6064	107.2881	105.7931	105.5133	104.2112	104.2112	103.9701	104.7128	105.5133	106.0792	106.6708	(39)
Average = Sum(39)m / 12 =												105.7917	(39)
HLP	Jan 1.1663	Feb 1.1628	Mar 1.1594	Apr 1.1432	May 1.1402	Jun 1.1261	Jul 1.1261	Aug 1.1235	Sep 1.1315	Oct 1.1402	Nov 1.1463	Dec 1.1527	(40)
HLP (average)												1.1432	(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	
East				4.8200	19.6403	0.7100	0.7000		0.7700		32.6050 (76)	
Southwest				0.6800	36.7938	0.7100	0.7000		0.7700		8.6173 (79)	
West				5.7600	19.6403	0.7100	0.7000		0.7700		38.9636 (80)	
Northwest				0.6800	11.2829	0.7100	0.7000		0.7700		2.6425 (81)	
East				3.1500	19.6403	0.7100	0.7000		0.7700		21.3082 (76)	
Solar gains	104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531	85.9101 (83)
Total gains	514.3168	609.6723	722.1118	846.4048	928.9097	919.4274	875.6357	801.9216	706.6779	587.6352	506.3913	483.7196 (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	44.5340	44.6684	44.8009	45.4340	45.5545	46.1237	46.1237	46.2307	45.9028	45.5545	45.3115	45.0602
alpha	3.9689	3.9779	3.9867	4.0289	4.0370	4.0749	4.0749	4.0820	4.0602	4.0370	4.0208	4.0040
util living area	0.9951	0.9898	0.9743	0.9269	0.8228	0.6584	0.5051	0.5649	0.8112	0.9610	0.9910	0.9961 (86)
MIT	19.3702	19.5732	19.9223	20.3709	20.7244	20.9215	20.9793	20.9678	20.8100	20.3234	19.7662	19.3404 (87)
Th 2	19.9470	19.9499	19.9526	19.9657	19.9681	19.9796	19.9796	19.9817	19.9752	19.9681	19.9632	19.9580 (88)
util rest of house	0.9938	0.9871	0.9674	0.9068	0.7756	0.5752	0.3963	0.4533	0.7432	0.9464	0.9882	0.9951 (89)
MIT 2	17.7690	18.0663	18.5731	19.2161	19.6854	19.9204	19.9699	19.9651	19.8074	19.1638	18.3578	17.7326 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.0830	18.3618	18.8377	19.4426	19.8892	20.1167	20.1678	20.1617	20.0041	19.3913	18.6341	18.0480 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9330	18.2118	18.6877	19.2926	19.7392	19.9667	20.0178	20.0117	19.8541	19.2413	18.4841	17.8980 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9899	0.9805	0.9557	0.8903	0.7635	0.5741	0.4005	0.4568	0.7338	0.9322	0.9821	0.9920 (94)
Useful gains	509.1294	597.7926	690.1465	753.5907	709.2199	527.8552	350.7126	366.2974	518.5835	547.8144	497.3470	479.8350 (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	1471.4287	1432.4389	1307.5959	1099.4661	848.2402	559.2725	356.1770	375.5134	602.5245	911.7689	1207.6126	1461.1750 (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	715.9507	560.8823	459.3823	249.0303	103.4311	0.0000	0.0000	0.0000	0.0000	270.7821	511.3913	730.1169 (98)
Space heating												3600.9670 (98)

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Space heating per m2 (98) / (4) = 38.9125 (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													4001.0744 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	715.9507	560.8823	459.3823	249.0303	103.4311	0.0000	0.0000	0.0000	0.0000	270.7821	511.3913	730.1169	(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)	795.5007	623.2025	510.4248	276.7003	114.9234	0.0000	0.0000	0.0000	0.0000	300.8690	568.2125	811.2410	(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	89.3175	89.2538	89.1065	88.7559	88.0679	86.7000	86.7000	86.7000	86.7000	88.7918	89.1836	86.7000	(216)
Fuel for water heating, kWh/month	201.3595	176.8889	184.3831	163.5618	159.7963	142.5096	134.4811	150.8755	151.6607	169.6753	181.5775	195.6692	(219)
Water heating fuel used												2012.4384	(219)
Annual totals kWh/year													
Space heating fuel - main system												4001.0744	(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 * 908 * 1.00) =												-588.2895	(233)
Total delivered energy for all uses												5898.9965	(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	4001.0744	0.2160	864.2321	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2012.4384	0.2160	434.6867	(264)
Space and water heating			1298.9188	(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	-588.2895	0.5190	-305.3223	(269)
Total CO2, kg/year			1239.4848	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.3900	(273)

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

DER			13.3900	ZC1
Total Floor Area		TFA	92.5400	
Assumed number of occupants		N	2.6589	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			15.6036	ZC2
CO2 emissions from cooking, equation (L16)			1.9755	ZC3
Total CO2 emissions			30.9691	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			30.9691	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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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	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																3 * 10 =	30.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
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										1 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.9250 (20)		
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3565 (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	0.4545	0.4456	0.4367	0.3922	0.3832	0.3387	0.3387	0.3298	0.3565	0.3832	0.4011	0.4189	(22b)				
Effective ac	0.6033	0.5993	0.5954	0.5769	0.5734	0.5574	0.5574	0.5544	0.5635	0.5734	0.5804	0.5877	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9600	1.0000	1.9600		(26)					
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	96.8900	17.0500	79.8400	0.1800	14.3712		(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, m2)			190.4400				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	48.4984	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6954 (36)					
Total fabric heat loss						(33) + (36) =	59.1938 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 44.1082	Feb 43.8149	Mar 43.5274	Apr 42.1772	May 41.9246	Jun 40.7485	Jul 40.7485	Aug 40.5307	Sep 41.2015	Oct 41.9246	Nov 42.4356	Dec 42.9699 (38)
Heat transfer coeff	103.3020	103.0087	102.7212	101.3710	101.1183	99.9423	99.9423	99.7245	100.3953	101.1183	101.6294	102.1637 (39)
Average = Sum(39)m / 12 =												101.3698 (39)
HLP	Jan 1.1163	Feb 1.1131	Mar 1.1100	Apr 1.0954	May 1.0927	Jun 1.0800	Jul 1.0800	Aug 1.0776	Sep 1.0849	Oct 1.0927	Nov 1.0982	Dec 1.1040 (40)
HLP (average)												1.0954 (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	Jan 107.0842	Feb 103.1902	Mar 99.2962	Apr 95.4022	May 91.5083	Jun 87.6143	Jul 87.6143	Aug 91.5083	Sep 95.4022	Oct 99.2962	Nov 103.1902	Dec 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)

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
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			
East				7.9700	19.6403	0.6300	0.7000	0.7700	47.8385 (76)			
Southwest				0.6800	36.7938	0.6300	0.7000	0.7700	7.6464 (79)			
West				5.7600	19.6403	0.6300	0.7000	0.7700	34.5734 (80)			
Northwest				0.6800	11.2829	0.6300	0.7000	0.7700	2.3448 (81)			
Solar gains	92.4030	179.0126	291.9183	423.4166	518.2602	530.5725	505.0877	434.0533	338.5599	211.5231	114.8668	76.2301 (83)
Total gains	512.6343	596.9990	694.9973	801.9530	871.7669	860.0776	819.5361	755.4848	673.0210	570.7492	501.8743	484.0981 (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	62.2097	62.3869	62.5615	63.3948	63.5532	64.3010	64.3010	64.4414	64.0109	63.5532	63.2336	62.9029
alpha	5.1473	5.1591	5.1708	5.2263	5.2369	5.2867	5.2867	5.2961	5.2674	5.2369	5.2156	5.1935
util living area	0.9986	0.9967	0.9895	0.9596	0.8697	0.6965	0.5271	0.5895	0.8523	0.9809	0.9971	0.9990 (86)
MIT	19.7611	19.9135	20.1804	20.5315	20.8131	20.9583	20.9920	20.9862	20.8777	20.4957	20.0654	19.7384 (87)
Th 2	19.9875	19.9901	19.9927	20.0046	20.0068	20.0172	20.0172	20.0191	20.0132	20.0068	20.0023	19.9976 (88)
util rest of house	0.9982	0.9956	0.9857	0.9444	0.8237	0.6081	0.4143	0.4727	0.7834	0.9712	0.9959	0.9987 (89)
MIT 2	18.3291	18.5534	18.9432	19.4516	19.8237	19.9896	20.0143	20.0134	19.9133	19.4107	18.7846	18.3030 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.6100	18.8202	19.1858	19.6634	20.0177	20.1796	20.2060	20.2042	20.1025	19.6235	19.0358	18.5845 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6100	18.8202	19.1858	19.6634	20.0177	20.1796	20.2060	20.2042	20.1025	19.6235	19.0358	18.5845 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9972	0.9936	0.9815	0.9378	0.8242	0.6237	0.4365	0.4956	0.7907	0.9661	0.9941	0.9979 (94)
Ext temp.	511.1954	593.1899	682.1605	752.1056	718.5483	536.4006	357.7569	374.3893	532.1252	551.3965	498.9130	483.0813 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Month fracti	1478.2508	1433.8986	1303.1059	1091.0949	841.0740	557.6341	360.3957	379.3724	602.6199	912.4388	1213.0317	1469.5740 (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	719.4893	564.9562	461.9833	244.0723	91.1591	0.0000	0.0000	0.0000	0.0000	268.6155	514.1655	733.9506 (98)
Space heating per m2												3598.3918 (98)
										(98) / (4) =		38.8847 (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													3852.6679 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	719.4893	564.9562	461.9833	244.0723	91.1591	0.0000	0.0000	0.0000	0.0000	268.6155	514.1655	733.9506	(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)	770.3311	604.8782	494.6288	261.3194	97.6008	0.0000	0.0000	0.0000	0.0000	287.5969	550.4984	785.8143	(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	87.9042	87.6804	87.1588	85.9319	83.6044	80.3000	80.3000	80.3000	80.3000	86.0523	87.4224	80.3000	(216)
Fuel for water heating, kWh/month	238.6252	210.8991	222.4929	200.1575	199.1827	182.6481	174.9908	195.0737	197.2281	209.5708	218.4071	232.7082	(219)
Water heating fuel used												2481.9841	(219)
Annual totals kWh/year													
Space heating fuel - main system												3852.6679	(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												6808.4253	(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	3852.6679	0.2160	832.1763	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2481.9841	0.2160	536.1086	(264)
Space and water heating			1368.2848	(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			1614.1731	(272)
Emissions per m2 for space and water heating			14.7859	(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) = (14.7859 * 1.00) + 2.2365 + 0.4206, rounded to 2 d.p.			17.4400	(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					4.5000
Infiltration rate					0.3604 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3334 (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	0.4251	0.4167	0.4084	0.3667	0.3584	0.3167	0.3167	0.3084	0.3334	0.3584	0.3751	0.3917 (22b)
Effective ac	0.5903	0.5868	0.5834	0.5672	0.5642	0.5502	0.5502	0.5475	0.5556	0.5642	0.5703	0.5767 (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)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (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)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
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			45.7700			9.0000	411.9300 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16891.8520 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							182.5357 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835 (36)
Total fabric heat loss						(33) + (36) =	63.0131 (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	43.1601	42.9037	42.6523	41.4715	41.2506	40.2222	40.2222	40.0317	40.6183	41.2506	41.6975	42.1647 (38)
Heat transfer coeff	106.1732	105.9168	105.6654	104.4846	104.2637	103.2353	103.2353	103.0448	103.6314	104.2637	104.7106	105.1778 (39)
Average = Sum(39)m / 12 =												104.4835 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1473	1.1446	1.1418	1.1291	1.1267	1.1156	1.1156	1.1135	1.1199	1.1267	1.1315	1.1366 (40)
HLP (average)												1.1291 (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	
East					4.8200	19.6403	0.7100	0.7000			0.7700	32.6050 (76)	
Southwest					0.6800	36.7938	0.7100	0.7000			0.7700	8.6173 (79)	
West					5.7600	19.6403	0.7100	0.7000			0.7700	38.9636 (80)	
Northwest					0.6800	11.2829	0.7100	0.7000			0.7700	2.6425 (81)	
East					3.1500	19.6403	0.7100	0.7000			0.7700	21.3082 (76)	
Solar gains	104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531	85.9101	(83)
Total gains	478.6314	574.8057	688.9471	815.5589	899.5708	892.2062	850.2088	774.1895	678.1223	556.6806	472.7336	448.8497	(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	44.1936	44.3006	44.4060	44.9079	45.0030	45.4513	45.4513	45.5353	45.2776	45.0030	44.8109	44.6119	
alpha	3.9462	3.9534	3.9604	3.9939	4.0002	4.0301	4.0301	4.0357	4.0185	4.0002	3.9874	3.9741	
util living area	0.9958	0.9910	0.9763	0.9306	0.8288	0.6671	0.5135	0.5765	0.8214	0.9650	0.9924	0.9968	(86)
MIT	19.3264	19.5331	19.8891	20.3449	20.7094	20.9147	20.9770	20.9639	20.7947	20.2903	19.7220	19.2923	(87)
Th 2	19.9624	19.9646	19.9668	19.9772	19.9791	19.9881	19.9881	19.9898	19.9847	19.9791	19.9752	19.9711	(88)
util rest of house	0.9948	0.9886	0.9700	0.9116	0.7832	0.5849	0.4046	0.4648	0.7561	0.9519	0.9900	0.9959	(89)
MIT 2	18.4303	18.6376	18.9914	19.4406	19.7733	19.9434	19.9806	19.9767	19.8585	19.3980	18.8348	18.4030	(90)
Living area fraction									fLA =	Living area / (4) =		0.1961	(91)
MIT	18.6061	18.8132	19.1674	19.6180	19.9569	20.1339	20.1760	20.1704	20.0421	19.5730	19.0088	18.5774	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6061	18.8132	19.1674	19.6180	19.9569	20.1339	20.1760	20.1704	20.0421	19.5730	19.0088	18.5774	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	475.1809	566.2451	663.9275	736.9667	703.5125	533.1628	361.8193	376.1550	515.6392	526.1461	466.5474	446.3155	(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	1518.9244	1473.6440	1338.5077	1119.8628	860.8912	571.2957	369.1708	388.5156	615.7924	935.5588	1246.9802	1512.1825	(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	776.5451	609.7720	501.8876	275.6852	117.0898	0.0000	0.0000	0.0000	0.0000	304.6030	561.9117	793.0051	(98)
Space heating												3940.4995	(98)
Space heating per m2										(98) / (4) =		42.5816	(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	970.4116	763.9410	783.1407	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8611	0.9148	0.8874	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	835.6177	698.8529	694.9466	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1143.8376	1092.6370	1005.6436	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	221.9183	292.9753	231.1586	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			746.0521	(104)
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	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	55.4796	73.2438	57.7896	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling													
Space cooling per m2												186.5130	(107)
Energy for space heating												2.0155	(108)
Energy for space cooling												42.5816	(99)
Total												2.0155	(108)
Dwelling Fabric Energy Efficiency (DFEE)												44.5971	(109)
												44.6	(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	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					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3565 (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	0.4545	0.4456	0.4367	0.3922	0.3832	0.3387	0.3387	0.3298	0.3565	0.3832	0.4011	0.4189 (22b)
Effective ac	0.6033	0.5993	0.5954	0.5769	0.5734	0.5574	0.5574	0.5544	0.5635	0.5734	0.5804	0.5877 (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 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	96.8900	17.0500	79.8400	0.1800	14.3712		(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)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.4984		(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)							10.6954 (36)
Total fabric heat loss						(33) + (36) =	59.1938 (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	44.1082	43.8149	43.5274	42.1772	41.9246	40.7485	40.7485	40.5307	41.2015	41.9246	42.4356	42.9699 (38)
Heat transfer coeff	103.3020	103.0087	102.7212	101.3710	101.1183	99.9423	99.9423	99.7245	100.3953	101.1183	101.6294	102.1637 (39)
Average = Sum(39)m / 12 =												101.3698 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1163	1.1131	1.1100	1.0954	1.0927	1.0800	1.0800	1.0776	1.0849	1.0927	1.0982	1.1040 (40)
HLP (average)												1.0954 (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 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)

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	(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	(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	(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	
East					7.9700	19.6403	0.6300	0.7000	0.7700		47.8385 (76)	
Southwest					0.6800	36.7938	0.6300	0.7000	0.7700		7.6464 (79)	
West					5.7600	19.6403	0.6300	0.7000	0.7700		34.5734 (80)	
Northwest					0.6800	11.2829	0.6300	0.7000	0.7700		2.3448 (81)	

Solar gains	92.4030	179.0126	291.9183	423.4166	518.2602	530.5725	505.0877	434.0533	338.5599	211.5231	114.8668	76.2301 (83)
Total gains	466.8977	552.0740	651.8781	761.7917	833.7600	824.8319	786.0707	719.0717	635.1306	529.8206	458.1474	439.1696 (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	62.2097	62.3869	62.5615	63.3948	63.5532	64.3010	64.3010	64.4414	64.0109	63.5532	63.2336	62.9029		
alpha	5.1473	5.1591	5.1708	5.2263	5.2369	5.2867	5.2867	5.2961	5.2674	5.2369	5.2156	5.1935		
util living area	0.9991	0.9977	0.9921	0.9669	0.8856	0.7186	0.5477	0.6152	0.8746	0.9861	0.9981	0.9994	(86)	
MIT	19.7147	19.8683	20.1385	20.4977	20.7928	20.9518	20.9905	20.9832	20.8590	20.4573	20.0212	19.6926	(87)	
Th 2	19.9875	19.9901	19.9927	20.0046	20.0068	20.0172	20.0172	20.0191	20.0132	20.0068	20.0023	19.9976	(88)	
util rest of house	0.9988	0.9969	0.9892	0.9539	0.8428	0.6302	0.4315	0.4953	0.8108	0.9788	0.9973	0.9992	(89)	
MIT 2	18.8089	18.9643	19.2350	19.5956	19.8660	19.9950	20.0148	20.0143	19.9324	19.5631	19.1270	18.7949	(90)	
Living area fraction									fLA = Living area / (4) =			0.1961	(91)	
MIT	18.9866	19.1416	19.4122	19.7725	20.0478	20.1826	20.2061	20.2043	20.1141	19.7385	19.3024	18.9710	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.9866	19.1416	19.4122	19.7725	20.0478	20.1826	20.2061	20.2043	20.1141	19.7385	19.3024	18.9710	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	466.1472	549.8440	643.3513	723.8520	704.3593	532.9453	357.2212	373.2099	519.8146	517.1489	456.5400	438.6575	(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	1517.1547	1467.0055	1326.3538	1102.1583	844.1124	557.9414	360.4068	379.3832	603.7875	924.0688	1240.1191	1509.0549	(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	781.9496	616.3325	508.1538	272.3805	103.9763	0.0000	0.0000	0.0000	0.0000	302.7484	564.1770	796.3757	(98)	
Space heating												3946.0937	(98)	
Space heating per m2												42.6420	(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	939.4577	739.5731	757.9064	0.0000	0.0000	0.0000	0.0000	(100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8887	0.9416	0.9169	0.0000	0.0000	0.0000	0.0000	(101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	834.8790	696.3824	694.9377	0.0000	0.0000	0.0000	0.0000	(102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1065.0884	1017.6703	941.2201	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														

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Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	165.7508	239.0382	183.2341	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												588.0230 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	41.4377	59.7595	45.8085	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												147.0058 (107)
Energy for space heating												1.5886 (108)
Energy for space cooling												42.6420 (99)
Total												1.5886 (108)
Target Fabric Energy Efficiency (TFEE)												44.2306 (109)
												50.9 (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	secondary	other	total	m3 per hour										
										heating	heating													
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										4.5000														
Infiltration rate										0.4055 (18)														
Number of sides sheltered										1 (19)														
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.9250 (20)									
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3751 (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													0.3939	0.3658	0.3751	0.3564	0.3564	0.3470	0.3376	0.3282	0.3189	0.3470	0.3282	0.3470 (22b)
Effective ac													0.5776	0.5669	0.5704	0.5635	0.5635	0.5602	0.5570	0.5539	0.5508	0.5602	0.5539	0.5602 (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)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(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)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
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			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(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	42.2270	41.4457	41.6997	41.1981	41.1981	40.9570	40.7223	40.4940	40.2722	40.9570	40.4940	40.9570	(38)
Heat transfer coeff	105.2401	104.4588	104.7128	104.2112	104.2112	103.9701	103.7354	103.5071	103.2852	103.9701	103.5071	103.9701	(39)
Average = Sum(39)m / 12 =												104.0649	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1372	1.1288	1.1315	1.1261	1.1261	1.1235	1.1210	1.1185	1.1161	1.1235	1.1185	1.1235	(40)
HLP (average)												1.1245	(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	Solar flux	g	FF	Access	Gains
		m2	Table 6a	W/m2	Specific data	factor	W
				or Table 6b	or Table 6c	Table 6d	
East		4.8200	25.1925	0.7100	0.7000	0.7700	41.8224 (76)
Southwest		0.6800	45.1778	0.7100	0.7000	0.7700	10.5809 (79)
West		5.7600	25.1925	0.7100	0.7000	0.7700	49.9786 (80)
Northwest		0.6800	14.6176	0.7100	0.7000	0.7700	3.4235 (81)
East		3.1500	25.1925	0.7100	0.7000	0.7700	27.3320 (76)

Solar gains	133.1375	219.5422	360.2956	524.0978	608.1362	675.6123	638.3866	563.2690	440.7991	279.7715	164.9897	107.9449 (83)
Total gains	741.1133	822.7244	939.9179	1067.1918	1113.7374	1147.7722	1091.1215	1024.8860	923.5484	799.2714	725.2862	699.1960 (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	45.6728	46.0144	45.9028	46.1237	46.1237	46.2307	46.3353	46.4375	46.5372	46.2307	46.2307	46.2307
alpha	4.0449	4.0676	4.0602	4.0749	4.0749	4.0820	4.0890	4.0958	4.1025	4.0820	4.0958	4.0820
util living area	0.9798	0.9689	0.9340	0.8466	0.7022	0.4989	0.3667	0.3886	0.6451	0.8811	0.9626	0.9829 (86)
MIT	19.7693	19.9266	20.2515	20.6241	20.8678	20.9745	20.9943	20.9931	20.9299	20.6253	20.1603	19.7552 (87)
Th 2	19.9705	19.9774	19.9752	19.9796	19.9796	19.9817	19.9837	19.9857	19.9877	19.9817	19.9857	19.9817 (88)
util rest of house	0.9749	0.9615	0.9183	0.8121	0.6412	0.4166	0.2732	0.2901	0.5613	0.8448	0.9519	0.9787 (89)
MIT 2	18.3629	18.5931	19.0514	19.5588	19.8576	19.9657	19.9817	19.9832	19.9358	19.5763	18.9377	18.3506 (90)
Living area fraction	18.6388	18.8547	19.2868	19.7678	20.0558	20.1635	20.1803	20.1813	20.1307	19.7821	19.1775	18.6261 (92)
MIT												
Temperature adjustment												-0.1500
adjusted MIT	18.4888	18.7047	19.1368	19.6178	19.9058	20.0135	20.0303	20.0313	19.9807	19.6321	19.0275	18.4761 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9650	0.9491	0.9022	0.7981	0.6364	0.4193	0.2775	0.2946	0.5607	0.8297	0.9385	0.9698 (94)
Ext temp.	715.1676	780.8848	848.0373	851.6989	708.8214	481.2475	302.7956	301.9442	517.8050	663.1620	680.6605	678.0595 (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	1430.0843	1400.2337	1270.8755	1054.3834	771.7628	490.0681	303.9762	303.4070	545.4220	855.8887	1151.7766	1401.1126 (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)
	531.8980	416.2024	314.5916	145.9328	46.8284	0.0000	0.0000	0.0000	0.0000	143.3887	339.2036	537.9515 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating
RHI space heating demand

2475.9971 (98)
2476 (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	secondary	other	total	m3 per hour			
										heating	heating						
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										4.5000							
Infiltration rate										0.4055 (18)							
Number of sides sheltered										1 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.9250 (20)		
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3751 (21)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)				
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)				
	0.4783	0.4689	0.4595	0.4126	0.4033	0.3564	0.3564	0.3470	0.3751	0.4033	0.4220	0.4408	(22b)				
Effective ac	0.6144	0.6099	0.6056	0.5851	0.5813	0.5635	0.5635	0.5602	0.5704	0.5813	0.5891	0.5971	(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)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(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)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
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			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 44.9180	Feb 44.5933	Mar 44.2750	Apr 42.7800	May 42.5003	Jun 41.1981	Jul 41.1981	Aug 40.9570	Sep 41.6997	Oct 42.5003	Nov 43.0661	Dec 43.6577	(38)
Heat transfer coeff	107.9311	107.6064	107.2881	105.7931	105.5133	104.2112	104.2112	103.9701	104.7128	105.5133	106.0792	106.6708	(39)
Average = Sum(39)m / 12 =												105.7917	(39)
HLP	Jan 1.1663	Feb 1.1628	Mar 1.1594	Apr 1.1432	May 1.1402	Jun 1.1261	Jul 1.1261	Aug 1.1235	Sep 1.1315	Oct 1.1402	Nov 1.1463	Dec 1.1527	(40)
HLP (average)												1.1432	(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												
Solar input	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		
East					4.8200	19.6403	0.7100	0.7000			0.7700			32.6050 (76)		
Southwest					0.6800	36.7938	0.7100	0.7000			0.7700			8.6173 (79)		
West					5.7600	19.6403	0.7100	0.7000			0.7700			38.9636 (80)		
Northwest					0.6800	11.2829	0.7100	0.7000			0.7700			2.6425 (81)		
East					3.1500	19.6403	0.7100	0.7000			0.7700			21.3082 (76)		
Solar gains					104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531	85.9101 (83)
Total gains					712.1125	804.9264	908.6096	1020.2778	1089.6722	1070.1067	1021.9608	950.7883	864.3009	757.8831	689.7496	677.1612 (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	44.5340	44.6684	44.8009	45.4340	45.5545	46.1237	46.1237	46.2307	45.9028	45.5545	45.3115	45.0602
alpha	3.9689	3.9779	3.9867	4.0289	4.0370	4.0749	4.0749	4.0820	4.0602	4.0370	4.0208	4.0040
util living area	0.9847	0.9741	0.9477	0.8804	0.7574	0.5856	0.4391	0.4874	0.7248	0.9178	0.9743	0.9873 (86)
MIT	19.6094	19.8015	20.1215	20.5153	20.8019	20.9487	20.9875	20.9811	20.8777	20.4897	19.9821	19.5769 (87)
Th 2	19.9470	19.9499	19.9526	19.9657	19.9681	19.9796	19.9796	19.9817	19.9752	19.9681	19.9632	19.9580 (88)
util rest of house	0.9810	0.9678	0.9350	0.8521	0.7041	0.5053	0.3417	0.3864	0.6490	0.8918	0.9671	0.9842 (89)
MIT 2	18.1156	18.3943	18.8528	19.4055	19.7724	19.9424	19.9739	19.9724	19.8739	19.3866	18.6674	18.0760 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.4086	18.6703	19.1016	19.6232	19.9743	20.1398	20.1727	20.1702	20.0708	19.6029	18.9253	18.3704 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.2586	18.5203	18.9516	19.4732	19.8243	19.9898	20.0227	20.0202	19.9208	19.4529	18.7753	18.2204 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9724	0.9562	0.9194	0.8362	0.6959	0.5061	0.3459	0.3904	0.6445	0.8754	0.9555	0.9766 (94)
Useful gains	692.4520	769.6907	835.3866	853.1450	758.2510	541.6139	353.4857	371.1712	557.0341	663.4597	659.0814	661.3363 (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	1506.5686	1465.6310	1335.9092	1118.5722	857.2262	561.6752	356.6853	376.3942	609.5113	934.1011	1238.5022	1495.5633 (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	605.7028	467.6719	372.3888	191.1075	73.6375	0.0000	0.0000	0.0000	0.0000	201.3573	417.1830	620.6649 (98)
Space heating												2949.7137 (98)

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Space heating per m2 (98) / (4) = 31.8750 (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													3277.4596 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	605.7028	467.6719	372.3888	191.1075	73.6375	0.0000	0.0000	0.0000	0.0000	201.3573	417.1830	620.6649	(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)	673.0031	519.6354	413.7653	212.3417	81.8195	0.0000	0.0000	0.0000	0.0000	223.7303	463.5366	689.6277	(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	89.2225	89.1437	88.9634	88.5451	87.8060	86.7000	86.7000	86.7000	86.7000	88.5574	89.0522	86.7000	(216)
Fuel for water heating, kWh/month	201.5738	177.1074	184.6798	163.9513	160.2731	142.5096	134.4811	150.8755	151.6607	170.1245	181.8454	89.2534	(217)
Water heating fuel used												195.8657	(219)
Annual totals kWh/year												2014.9479	(219)
Space heating fuel - main system													3277.4596 (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 + 908 + 1.00) =											-588.2895		-588.2895 (233)
Total delivered energy for all uses													5177.8912 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3277.4596	3.4800	114.0556	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2014.9479	3.4800	70.1202	(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	-588.2895	13.1900	-77.5954	(252)
Total energy cost			289.0711	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8827	(257)
SAP value		87.6860	
SAP rating (Section 12)		88	(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	3277.4596	0.2160	707.9313	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.9479	0.2160	435.2287	(264)
Space and water heating			1143.1600	(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	-588.2895	0.5190	-305.3223	(269)
Total kg/year			1083.7260	(272)
CO2 emissions per m2			11.7100	(273)
EI value			89.4417	
EI rating			89	(274)
EI band			B	

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Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
Water heating energy efficiency	$3.48 / 0.8811 = 3.950$, stars = 4
Water heating environmental impact	$0.216 / 0.8811 = 0.2451$, 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 * 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					4.5000
Infiltration rate					0.4055 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.3751 (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	0.3939	0.3658	0.3751	0.3564	0.3564	0.3470	0.3376	0.3282	0.3189	0.3470	0.3282	0.3470 (22b)
Effective ac	0.5776	0.5669	0.5704	0.5635	0.5635	0.5602	0.5570	0.5539	0.5508	0.5602	0.5539	0.5602 (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)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (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)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
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			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17303.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							186.9871 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835 (36)
Total fabric heat loss						(33) + (36) =	63.0131 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.2270	41.4457	41.6997	41.1981	41.1981	40.9570	40.7223	40.4940	40.2722	40.9570	40.4940	Dec 40.9570 (38)
Heat transfer coeff	105.2401	104.4588	104.7128	104.2112	104.2112	103.9701	103.7354	103.5071	103.2852	103.9701	103.5071	103.9701 (39)
Average = Sum(39)m / 12 =												104.0649 (39)

HLP	Jan 1.1372	Feb 1.1288	Mar 1.1315	Apr 1.1261	May 1.1261	Jun 1.1235	Jul 1.1210	Aug 1.1185	Sep 1.1161	Oct 1.1235	Nov 1.1185	Dec 1.1235 (40)
HLP (average)												1.1245 (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)
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			

East				4.8200	25.1925	0.7100	0.7000	0.7700	41.8224 (76)			
Southwest				0.6800	45.1778	0.7100	0.7000	0.7700	10.5809 (79)			
West				5.7600	25.1925	0.7100	0.7000	0.7700	49.9786 (80)			
Northwest				0.6800	14.6176	0.7100	0.7000	0.7700	3.4235 (81)			
East				3.1500	25.1925	0.7100	0.7000	0.7700	27.3320 (76)			

Solar gains	133.1375	219.5422	360.2956	524.0978	608.1362	675.6123	638.3866	563.2690	440.7991	279.7715	164.9897	107.9449 (83)
Total gains	741.1133	822.7244	939.9179	1067.1918	1113.7374	1147.7722	1091.1215	1024.8860	923.5484	799.2714	725.2862	699.1960 (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	45.6728	46.0144	45.9028	46.1237	46.1237	46.2307	46.3353	46.4375	46.5372	46.2307	46.4375	46.2307
alpha	4.0449	4.0676	4.0602	4.0749	4.0749	4.0820	4.0890	4.0958	4.1025	4.0820	4.0958	4.0820
util living area	0.9798	0.9689	0.9340	0.8466	0.7022	0.4989	0.3667	0.3886	0.6451	0.8811	0.9626	0.9829 (86)
MIT	19.7693	19.9266	20.2515	20.6241	20.8678	20.9745	20.9943	20.9931	20.9299	20.6253	20.1603	19.7552 (87)
Th 2	19.9705	19.9774	19.9752	19.9796	19.9796	19.9817	19.9837	19.9857	19.9877	19.9817	19.9857	19.9817 (88)
util rest of house	0.9749	0.9615	0.9183	0.8121	0.6412	0.4166	0.2732	0.2901	0.5613	0.8448	0.9519	0.9787 (89)
MIT 2	18.3629	18.5931	19.0514	19.5588	19.8576	19.9657	19.9817	19.9832	19.9358	19.5763	18.9377	18.3506 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.6388	18.8547	19.2868	19.7678	20.0558	20.1635	20.1803	20.1813	20.1307	19.7821	19.1775	18.6261 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4888	18.7047	19.1368	19.6178	19.9058	20.0135	20.0303	20.0313	19.9807	19.6321	19.0275	18.4761 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9650	0.9491	0.9022	0.7981	0.6364	0.4193	0.2775	0.2946	0.5607	0.8297	0.9385	0.9698 (94)
Useful gains	715.1676	780.8848	848.0373	851.6989	708.8214	481.2475	302.7956	301.9442	517.8050	663.1620	680.6605	678.0595 (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	1430.0843	1400.2337	1270.8755	1054.3834	771.7628	490.0681	303.9762	303.4070	545.4220	855.8887	1151.7766	1401.1126 (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	531.8980	416.2024	314.5916	145.9328	46.8284	0.0000	0.0000	0.0000	0.0000	143.3887	339.2036	537.9515 (98)
Space heating												2475.9971 (98)

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Space heating per m2 (98) / (4) = 26.7560 (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													2751.1079 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	531.8980	416.2024	314.5916	145.9328	46.8284	0.0000	0.0000	0.0000	0.0000	143.3887	339.2036	537.9515	(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)	590.9978	462.4471	349.5463	162.1475	52.0316	0.0000	0.0000	0.0000	0.0000	159.3208	376.8929	597.7238	(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	89.1426	89.0677	88.8399	88.3235	87.5010	86.7000	86.7000	86.7000	86.7000	88.2784	88.9065	86.7000	(216)
Fuel for water heating, kWh/month	201.7543	177.2585	184.9366	164.3626	160.8316	142.5096	134.4811	150.8755	151.6607	170.6621	182.1434	196.0542	(219)
Water heating fuel used												2017.5302	(219)
Annual totals kWh/year													
Space heating fuel - main system												2751.1079	(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 * 1031 * 1.00) =										-668.0993		-668.0993	(233)
Total delivered energy for all uses												4574.3119	(238)

10a. Fuel costs - using BEDF prices (450)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2751.1079	3.9300	108.1185 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2017.5302	3.9300	79.2889 (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	-668.0993	17.5600	-117.3182 (252)
Total energy cost			241.2838 (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	2751.1079	0.2160	594.2393 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2017.5302	0.2160	435.7865 (264)
Space and water heating			1030.0258 (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	-668.0993	0.5190	-346.7435 (269)
Total kg/year			929.1706 (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	2751.1079	1.2200	3356.3516 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2017.5302	1.2200	2461.3868 (264)
Space and water heating			5817.7384 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	398.7732	3.0700	1224.2338 (268)

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Energy saving/generation technologies			
PV Unit	-668.0993	3.0700	-2051.0649 (269)
Primary energy kWh/year			5221.1573 (272)
Primary energy kWh/m2/year			56.4205 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 88
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 (21.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£31 2.11 kg/m²	B 89	B 91
Total Savings	£31 2.11 kg/m²		

Potential energy efficiency rating:	B 89
Potential environmental impact rating:	B 91

Fuel prices for cost data on this page from database revision number 450 TEST (30 Oct 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	£275	£235	£40
Space heating	£209	£209	£0
Water heating	£79	£48	£31
Lighting	£70	£70	£0
Generated (PV)	-£117	-£117	£0
Total cost of fuels	£241	£210	£31
Total cost of uses	£241	£210	£31
Delivered energy	49 kWh/m²	39 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	56 kWh/m²	45 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	secondary	other	total	m3 per hour			
										heating	heating						
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										4.5000							
Infiltration rate										0.4055 (18)							
Number of sides sheltered										1 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.9250 (20)		
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3751 (21)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)				
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)				
	0.4783	0.4689	0.4595	0.4126	0.4033	0.3564	0.3564	0.3470	0.3751	0.4033	0.4220	0.4408	(22b)				
Effective ac	0.6144	0.6099	0.6056	0.5851	0.5813	0.5635	0.5635	0.5602	0.5704	0.5813	0.5891	0.5971	(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)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(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)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
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			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 44.9180	Feb 44.5933	Mar 44.2750	Apr 42.7800	May 42.5003	Jun 41.1981	Jul 41.1981	Aug 40.9570	Sep 41.6997	Oct 42.5003	Nov 43.0661	Dec 43.6577	(38)
Heat transfer coeff	107.9311	107.6064	107.2881	105.7931	105.5133	104.2112	104.2112	103.9701	104.7128	105.5133	106.0792	106.6708	(39)
Average = Sum(39)m / 12 =												105.7917	(39)
HLP	Jan 1.1663	Feb 1.1628	Mar 1.1594	Apr 1.1432	May 1.1402	Jun 1.1261	Jul 1.1261	Aug 1.1235	Sep 1.1315	Oct 1.1402	Nov 1.1463	Dec 1.1527	(40)
HLP (average)												1.1432	(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)
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

East				4.8200	19.6403		0.7100		0.7000		0.7700		32.6050 (76)
Southwest				0.6800	36.7938		0.7100		0.7000		0.7700		8.6173 (79)
West				5.7600	19.6403		0.7100		0.7000		0.7700		38.9636 (80)
Northwest				0.6800	11.2829		0.7100		0.7000		0.7700		2.6425 (81)
East				3.1500	19.6403		0.7100		0.7000		0.7700		21.3082 (76)

Solar gains	104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531		85.9101 (83)
Total gains	712.1125	804.9264	908.6096	1020.2778	1089.6722	1070.1067	1021.9608	950.7883	864.3009	757.8831	689.7496		677.1612 (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	44.5340	44.6684	44.8009	45.4340	45.5545	46.1237	46.1237	46.2307	45.9028	45.5545	45.3115	45.0602
alpha	3.9689	3.9779	3.9867	4.0289	4.0370	4.0749	4.0749	4.0820	4.0602	4.0370	4.0208	4.0040
util living area	0.9847	0.9741	0.9477	0.8804	0.7574	0.5856	0.4391	0.4874	0.7248	0.9178	0.9743	0.9873 (86)
MIT	19.6094	19.8015	20.1215	20.5153	20.8019	20.9487	20.9875	20.9811	20.8777	20.4897	19.9821	19.5769 (87)
Th 2	19.9470	19.9499	19.9526	19.9657	19.9681	19.9796	19.9796	19.9817	19.9752	19.9681	19.9632	19.9580 (88)
util rest of house	0.9810	0.9678	0.9350	0.8521	0.7041	0.5053	0.3417	0.3864	0.6490	0.8918	0.9671	0.9842 (89)
MIT 2	18.1156	18.3943	18.8528	19.4055	19.7724	19.9424	19.9739	19.9724	19.8739	19.3866	18.6674	18.0760 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.4086	18.6703	19.1016	19.6232	19.9743	20.1398	20.1727	20.1702	20.0708	19.6029	18.9253	18.3704 (92)

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment
adjusted MIT 18.2586 18.5203 18.9516 19.4732 19.8243 19.9898 20.0227 20.0202 19.9208 19.4529 18.7753 -0.1500
18.2204 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9724	0.9562	0.9194	0.8362	0.6959	0.5061	0.3459	0.3904	0.6445	0.8754	0.9555	0.9766	(94)
Useful gains	692.4520	769.6907	835.3866	853.1450	758.2510	541.6139	353.4857	371.1712	557.0341	663.4597	659.0814	661.3363	(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	1506.5686	1465.6310	1335.9092	1118.5722	857.2262	561.6752	356.6853	376.3942	609.5113	934.1011	1238.5022	1495.5633	(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	605.7028	467.6719	372.3888	191.1075	73.6375	0.0000	0.0000	0.0000	0.0000	201.3573	417.1830	620.6649	(98)
Space heating												2949.7137	(98)
Space heating per m2												31.8750	(99)

(98) / (4) =

8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3277.4596 (211)
Space heating requirement	605.7028	467.6719	372.3888	191.1075	73.6375	0.0000	0.0000	0.0000	0.0000	201.3573	417.1830	620.6649	(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)	673.0031	519.6354	413.7653	212.3417	81.8195	0.0000	0.0000	0.0000	0.0000	223.7303	463.5366	689.6277	(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 (217)m	89.3079	89.3235	89.3191	89.2955	89.1889	86.7000	86.7000	86.7000	86.7000	88.8973	89.1827	86.7000	(216)
Fuel for water heating, kWh/month	173.3942	130.0570	104.4156	55.9611	25.9199	9.1406	2.8745	35.8902	61.6042	109.4960	148.3363	172.2941	(219)
Water heating fuel used												1029.3838	(219)
Annual totals kWh/year													
Space heating fuel - main system													3277.4596 (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 * 908 * 1.00) =									-588.2895				-588.2895 (233)
Total delivered energy for all uses													4242.3271 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3277.4596	3.4800	114.0556	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1029.3838	3.4800	35.8226	(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	-588.2895	13.1900	-77.5954	(252)
Total energy cost			261.3684	(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] =	0.7981 (257)
SAP value		88.8661
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	3277.4596	0.2160	707.9313 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1029.3838	0.2160	222.3469 (264)
Space and water heating			930.2782 (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	-588.2895	0.5190	-305.3223 (269)
Total kg/year			896.7942 (272)
CO2 emissions per m2			9.6900 (273)
EI value			91.2629
EI rating			91 (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	secondary	other	total	m3 per hour										
										heating	heating													
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										4.5000														
Infiltration rate										0.4055 (18)														
Number of sides sheltered										1 (19)														
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.9250 (20)									
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3751 (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													0.3939	0.3658	0.3751	0.3564	0.3564	0.3470	0.3376	0.3282	0.3189	0.3470	0.3282	0.3470 (22b)
Effective ac													0.5776	0.5669	0.5704	0.5635	0.5635	0.5602	0.5570	0.5539	0.5508	0.5602	0.5539	0.5602 (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)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(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)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
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			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(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	42.2270	41.4457	41.6997	41.1981	41.1981	40.9570	40.7223	40.4940	40.2722	40.9570	40.4940	40.9570	(38)
Heat transfer coeff	105.2401	104.4588	104.7128	104.2112	104.2112	103.9701	103.7354	103.5071	103.2852	103.9701	103.5071	103.9701	(39)
Average = Sum(39)m / 12 =												104.0649	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1372	1.1288	1.1315	1.1261	1.1261	1.1235	1.1210	1.1185	1.1161	1.1235	1.1185	1.1235	(40)
HLP (average)												1.1245	(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	
East					4.8200	25.1925		0.7100	0.7000	0.7700	41.8224 (76)	
Southwest					0.6800	45.1778		0.7100	0.7000	0.7700	10.5809 (79)	
West					5.7600	25.1925		0.7100	0.7000	0.7700	49.9786 (80)	
Northwest					0.6800	14.6176		0.7100	0.7000	0.7700	3.4235 (81)	
East					3.1500	25.1925		0.7100	0.7000	0.7700	27.3320 (76)	
Solar gains	133.1375	219.5422	360.2956	524.0978	608.1362	675.6123	638.3866	563.2690	440.7991	279.7715	164.9897	107.9449 (83)
Total gains	741.1133	822.7244	939.9179	1067.1918	1113.7374	1147.7722	1091.1215	1024.8860	923.5484	799.2714	725.2862	699.1960 (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	45.6728	46.0144	45.9028	46.1237	46.1237	46.2307	46.3353	46.4375	46.5372	46.2307	46.4375	46.2307
alpha	4.0449	4.0676	4.0602	4.0749	4.0749	4.0820	4.0890	4.0958	4.1025	4.0820	4.0958	4.0820
util living area	0.9798	0.9689	0.9340	0.8466	0.7022	0.4989	0.3667	0.3886	0.6451	0.8811	0.9626	0.9829 (86)
MIT	19.7693	19.9266	20.2515	20.6241	20.8678	20.9745	20.9943	20.9931	20.9299	20.6253	20.1603	19.7552 (87)
Th 2	19.9705	19.9774	19.9752	19.9796	19.9796	19.9817	19.9837	19.9857	19.9877	19.9817	19.9857	19.9817 (88)
util rest of house	0.9749	0.9615	0.9183	0.8121	0.6412	0.4166	0.2732	0.2901	0.5613	0.8448	0.9519	0.9787 (89)
MIT 2	18.3629	18.5931	19.0514	19.5588	19.8576	19.9657	19.9817	19.9832	19.9358	19.5763	18.9377	18.3506 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.6388	18.8547	19.2868	19.7678	20.0558	20.1635	20.1803	20.1813	20.1307	19.7821	19.1775	18.6261 (92)

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Temperature adjustment													-0.1500
adjusted MIT	18.4888	18.7047	19.1368	19.6178	19.9058	20.0135	20.0303	20.0313	19.9807	19.6321	19.0275		18.4761 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9650	0.9491	0.9022	0.7981	0.6364	0.4193	0.2775	0.2946	0.5607	0.8297	0.9385	0.9698	(94)
Useful gains	715.1676	780.8848	848.0373	851.6989	708.8214	481.2475	302.7956	301.9442	517.8050	663.1620	680.6605	678.0595	(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													
	1430.0843	1400.2337	1270.8755	1054.3834	771.7628	490.0681	303.9762	303.4070	545.4220	855.8887	1151.7766	1401.1126	(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													
	531.8980	416.2024	314.5916	145.9328	46.8284	0.0000	0.0000	0.0000	0.0000	143.3887	339.2036	537.9515	(98)
Space heating													2475.9971 (98)
Space heating per m2											(98) / (4) =		26.7560 (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													2751.1079 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	531.8980	416.2024	314.5916	145.9328	46.8284	0.0000	0.0000	0.0000	0.0000	143.3887	339.2036	537.9515	(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)	590.9978	462.4471	349.5463	162.1475	52.0316	0.0000	0.0000	0.0000	0.0000	159.3208	376.8929	597.7238	(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	89.2504	89.2580	89.2261	89.1502	88.7505	86.7000	86.7000	86.7000	86.7000	88.6697	89.0745	86.7000	(216)
Fuel for water heating, kWh/month	168.7518	130.3032	104.0522	54.6948	30.9741	2.9966	0.0000	28.6331	55.9534	105.2101	142.9780	168.9238	(219)
Water heating fuel used													993.4710 (219)
Annual totals kWh/year													
Space heating fuel - main system													2751.1079 (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 * 1031 * 1.00) =										-668.0993			-668.0993 (233)
Total delivered energy for all uses													3600.2528 (238)

10a. Fuel costs - using BEDF prices (450)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2751.1079	3.9300	108.1185	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	993.4710	3.9300	39.0434	(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	-668.0993	17.5600	-117.3182	(252)
Total energy cost			209.8183	(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	2751.1079	0.2160	594.2393	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	993.4710	0.2160	214.5897	(264)
Space and water heating			808.8290	(265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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	-668.0993	0.5190	-346.7435 (269)
Total kg/year			733.9238 (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	2751.1079	1.2200	3356.3516 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	993.4710	1.2200	1212.0347 (264)
Space and water heating			4568.3863 (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	-668.0993	3.0700	-2051.0649 (269)
Primary energy kWh/year			4125.3052 (272)
Primary energy kWh/m2/year			44.5786 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	187.0 (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	63.01 (37)
Summer heat loss coefficient	355.46 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
North 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
East	4.8200	125.2818	0.7100	0.7000	0.9000	243.0952
South West	0.6800	127.3119	0.7100	0.7000	0.9000	34.8513
West	5.7600	125.2818	0.7100	0.7000	0.9000	290.5038
North West	0.6800	106.0502	0.7100	0.7000	0.9000	29.0310
East	3.1500	125.2818	0.7100	0.7000	0.9000	158.8693

total: 756.3506

	Jun	Jul	Aug	
Solar gains	814	756	665	(P3)
Internal gains	469	450	459	
Total summer gains	1283	1206	1124	(P5)

Summer gain/loss ratio	3.61	3.39	3.16	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 187.0)	0.69	0.69	0.69	
Threshold temperature	19.70	21.38	21.15	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight