

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	X411 Det				Issued on Date	15/12/2022
Assessment Reference	X411 Det			Prop Type Ref	Willow	
Property	4 Bed, K, WC, B, En					
SAP Rating	87 B	DER	12.94	TER	16.19	
Environmental	88 B	% DER<TER	20.10			
CO ₂ Emissions (t/year)	1.49	DFEE	43.76	TFEE	55.38	
General Requirements Compliance	Pass	% DFEE<TFEE	20.97			
Assessor Details	Mr. Christopher MacDougall, Chris MacDougall, Tel: 02032 902 902, chris.macdougall@aessc.co.uk				Assessor ID	Q920-0001
Client						

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

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DWELLING AS DESIGNED

Detached House, total floor area 137 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) 16.19 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 12.94 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)55.4 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.28 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.24 (max. 2.00)	1.80 (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:	4.01 (design value)	
Maximum	10.0	OK

4 Heating efficiency

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

Data from database

Ideal LOGIC COMBI ESP1 35

Combi boiler

Efficiency: 89.6% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: 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

Continuous extract system (decentralised)

Specific fan power: 0.1700 0.1800

Maximum 0.7 OK

9 Summertime temperature

Overheating risk (Thames Valley): Medium OK

Based on:

Overshading:

Average

Windows facing North East: 2.25 m², No overhang

Windows facing South East: 10.12 m², No overhang

Windows facing South West: 2.36 m², No overhang

Windows facing North West: 10.94 m², No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

10 Key features

External wall U-value 0.12 W/m²K

Party wall U-value 0.00 W/m²K

Roof U-value 0.09 W/m²K

Roof U-value 0.12 W/m²K

Floor U-value 0.11 W/m²K

Door U-value 1.00 W/m²K

Thermal bridging y-value 0.027 W/m²K

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (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					0 * 10 = 0.0000 (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) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.2005 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2005 (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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
Effective ac	0.5056	0.5006	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	84.5631	(33)
1F Timber						9.0000	739.4400 (32c)
GF Masonry						39.0000	1107.2100 (32c)
GF Timber						9.0000	396.1800 (32c)
2F Timber						9.0000	553.5000 (32c)
Internal Floor						12.6000	1080.9540 (32d)
Internal Ceiling						9.0000	772.1100 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16730.7660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 122.2473 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2314 (36)
Total fabric heat loss (33) + (36) = 92.7945 (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	54.8824	54.3384	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705 (38)
Heat transfer coeff	147.6770	147.1329	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651 (39)
Average = Sum(39)m / 12 =												147.1217 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0790	1.0751	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9109 (42)											
Average daily hot water use (litres/day)	103.3328 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Energy content (annual)	Total = Sum(45)m =											1625.8273 (45)
Distribution loss (46)m = 0.15 x (45)m	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1611	12.7791	14.1217	13.6311	14.0532	13.5579	13.9837	14.0288	13.5964	14.0871	13.6736	14.1483 (61)
Total heat required for water heating calculated for each month	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (62)
WWHRS	-53.2248	-46.8328	-47.7980	-39.3148	-36.4983	-30.1049	-25.4708	-30.8420	-31.7453	-39.2520	-45.4799	-51.4469 eq. (G10)
Total of WWHRS savings												-478.0106
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462 (64)
	Total per year (kWh/year) = Sum(64)m =											1313.6387 (64)
Heat gains from water heating, kWh/month	59.5876	52.2142	54.1140	47.5078	45.8283	39.9041	37.3321	42.3347	42.6903	49.3119	53.4019	57.8160 (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	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5792	24.4956	19.9212	15.0816	11.2737	9.5177	10.2842	13.3678	17.9423	22.7818	26.5897	28.3457 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.8127	308.9861	300.9893	283.9650	262.4749	242.2773	228.7840	225.6106	233.6074	250.6317	272.1218	292.3194 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	80.0909	77.6996	72.7339	65.9831	61.5972	55.4224	50.1776	56.9015	59.2921	66.2795	74.1693	77.7096 (72)
Total internal gains	483.1456	480.8441	463.3071	434.6925	405.0086	376.8802	358.9086	365.5428	380.5047	409.3558	442.5437	468.0376 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d	Gains W		
Northeast				2.2500	11.2829	0.4600	0.0000		0.7700	8.9919 (75)		
Southeast				10.1200	36.7938	0.4600	0.0000		0.7700	131.8876 (77)		
Southwest				2.3600	36.7938	0.4600	0.0000		0.7700	30.7564 (79)		
Northwest				5.2500	11.2829	0.4600	0.0000		0.7700	20.9812 (81)		
Northwest				5.6900	11.2829	0.4300	0.0000		0.7700	21.2566 (81)		
Northwest				0.5500	16.3666	0.7100	0.7000		1.0000	4.0264 (82)		
Solar gains	217.9002	389.6095	582.2256	804.0279	976.1714	1002.4111	952.5703	819.0210	658.2124	443.8376	264.3495	184.3080 (83)
Total gains	701.0458	870.4536	1045.5327	1238.7203	1381.1801	1379.2913	1311.4789	1184.5637	1038.7170	853.1934	706.8932	652.3456 (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	31.4703	31.5866	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012
alpha	3.0980	3.1058	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067
util living area	0.9854	0.9713	0.9412	0.8726	0.7528	0.5989	0.4639	0.5233	0.7476	0.9207	0.9755	0.9882 (86)
MIT	18.9106	19.2050	19.6466	20.1767	20.6135	20.8643	20.9545	20.9333	20.7193	20.1232	19.4036	18.8480 (87)
Th 2	20.0180	20.0213	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217 (88)
util rest of house	0.9828	0.9663	0.9307	0.8497	0.7090	0.5284	0.3714	0.4282	0.6863	0.9013	0.9704	0.9861 (89)
MIT 2	17.2046	17.6332	18.2689	19.0152	19.5995	19.9034	19.9938	19.9778	19.7489	18.9574	17.9256	17.1157 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.3900	17.8040	18.4186	19.1414	19.7097	20.0078	20.0982	20.0816	19.8544	19.0841	18.0862	17.3039 (92)
Temperature adjustment	-0.1500											
adjusted MIT	17.2400	17.6540	18.2686	18.9914	19.5597	19.8578	19.9482	19.9316	19.7044	18.9341	17.9362	17.1539 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9712	0.9485	0.9053	0.8200	0.6855	0.5156	0.3641	0.4188	0.6632	0.8726	0.9538	0.9762 (94)
Useful gains	680.8505	825.5947	946.5716	1015.7610	946.8455	711.2046	477.4743	496.0746	688.9229	744.4978	674.2589	636.7933 (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												
	1910.9343	1876.5282	1730.7428	1484.0872	1155.8811	773.2392	492.4018	519.3751	824.2051	1225.6520	1593.6241	1905.0729 (97a)
Month fracti	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												
	915.1823	706.2274	583.4234	337.1949	155.5225	0.0000	0.0000	0.0000	0.0000	357.9788	661.9429	943.6001 (98)
Space heating												4661.0722 (98)
Space heating per m2												34.0572 (99)
										(98) / (4) =		

Not applicable

[illegible]

(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)		
mechanical ventilation fans (SFP = 0.2294)		92.0650 (230a)
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
Total electricity for the above, kWh/year		167.0650 (231)
Electricity for lighting (calculated in Appendix L)		487.0571 (232)
Total delivered energy for all uses		7278.8143 (238)

	Energy	Emission factor	Emissions
	kWh/year	kg CO ₂ /kWh	kg CO ₂ /year
Space heating - main system 1	5150.3561	0.2160	1112.4765 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1474.3361	0.2160	318.4566 (264)
Space and water heating			1430.9335 (265)
Pumps and fans	167.0650	0.5190	86.7068 (267)
Energy for lighting	487.0571	0.5190	252.7826 (268)
Total CO ₂ , kg/year			1770.4229 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.9400 (273)

Net CO2 Emissions Associated with Appliances and Cooking and Site-Wide Electricity Generation Technologies			
DER			12.9400 ZC1
Total Floor Area	TFA		136.8600
Assumed number of occupants	N		2.9109
CO2 emission factor in Table 12 for electricity displaced from grid	EF		0.5190
CO2 emissions from appliances, equation (L14)			13.2411 ZC2
CO2 emissions from cooking, equation (L16)			1.3800 ZC3
Total CO2 emissions			27.5611 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m ² /year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			27.5611 ZC8

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Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1216 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3716 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3716 (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	0.4738	0.4645	0.4552	0.4088	0.3995	0.3530	0.3530	0.3437	0.3716	0.3995	0.4181	0.4366 (22b)
Effective ac	0.6122	0.6079	0.6036	0.5835	0.5798	0.5623	0.5623	0.5591	0.5690	0.5798	0.5874	0.5953 (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			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			25.6700	1.3258	34.0322		(27)
TER Room Window (Uw = 1.70)			0.5500	1.5918	0.8755		(27a)
FP McCann System			51.0700	0.1300	6.6391		(28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.1800	25.7292		(29a)
WTV	20.8500		20.8500	0.1800	3.7530		(29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.1800	0.6210		(29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.1300	3.2253		(30)
Bay Plane	1.2200		1.2200	0.1300	0.1586		(30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1300	1.4248		(30)
Dormer Roof	2.9900		2.9900	0.1300	0.3887		(30)
CTV	13.9300		13.9300	0.1300	1.8109		(30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		80.8083		(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)							14.0858 (36)
Total fabric heat loss						(33) + (36) =	94.8941 (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	66.4539	65.9808	65.5170	63.3389	62.9314	61.0344	61.0344	60.6831	61.7651	62.9314	63.7558	64.6177 (38)
Heat transfer coeff	161.3479	160.8748	160.4111	158.2330	157.8255	155.9284	155.9284	155.5771	156.6591	157.8255	158.6499	159.5118 (39)
Average = Sum(39)m / 12 =												158.2311 (39)
HLP	1.1789	1.1755	1.1721	1.1562	1.1532	1.1393	1.1393	1.1368	1.1447	1.1532	1.1592	1.1655 (40)
HLP (average)												1.1562 (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												2.9109 (42)
Average daily hot water use (litres/day)												103.3328 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Energy content (annual)										Total =	Sum (45)m =	1625.8273 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (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	50.9589	46.0274	50.9589	49.3151	49.4978	45.8628	47.3915	49.4978	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	219.5224	193.4541	203.0901	181.9467	176.7610	155.6813	149.1545	166.2723	167.4842	188.6737	199.6415	214.2037 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
										Solar input (sum of months) =	Sum (63)m =	0.0000 (63)
Output from w/h												
	219.5224	193.4541	203.0901	181.9467	176.7610	155.6813	149.1545	166.2723	167.4842	188.6737	199.6415	214.2037 (64)
										Total per year (kWh/year) =	Sum (64)m =	2215.8855 (64)
Heat gains from water heating, kWh/month												
	68.7871	60.5262	63.3233	56.4288	54.6895	47.9803	45.6841	51.2020	51.6200	58.5299	62.3123	67.0186 (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	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	27.5792	24.4956	19.9212	15.0816	11.2737	9.5177	10.2842	13.3678	17.9423	22.7818	26.5897	28.3457 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	305.8127	308.9861	300.9893	283.9650	262.4749	242.2773	228.7840	225.6106	233.6074	250.6317	272.1218	292.3194 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543 (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)												
	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)												
	92.4558	90.0688	85.1120	78.3733	73.5074	66.6394	61.4033	68.8199	71.6945	78.6692	86.5449	90.0788 (72)
Total internal gains												
	495.5105	493.2133	475.6853	447.0827	416.9188	388.0972	370.1344	377.4611	392.9070	421.7455	454.9192	480.4067 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
Northeast					2.2500	11.2829	0.6300	0.7000	0.7700			7.7585 (75)
Southeast					10.1200	36.7938	0.6300	0.7000	0.7700			113.7961 (77)
Southwest					2.3600	36.7938	0.6300	0.7000	0.7700			26.5374 (79)
Northwest					10.9400	11.2829	0.6300	0.7000	0.7700			37.7235 (81)
Northwest					0.5500	16.3666	0.6300	0.7000	1.0000			3.5727 (82)
Solar gains	189.3882	338.9729	507.4266	702.0751	853.4914	876.8809	833.1015	715.5905	574.1024	386.3878	229.8221	160.1511 (83)
Total gains	684.8987	832.1862	983.1118	1149.1578	1270.4102	1264.9781	1203.2359	1093.0517	967.0094	808.1333	684.7414	640.5579 (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	58.9048	59.0780	59.2488	60.0644	60.2195	60.9521	60.9521	61.0897	60.6678	60.2195	59.9065	59.5829
alpha	4.9270	4.9385	4.9499	5.0043	5.0146	5.0635	5.0635	5.0726	5.0445	5.0146	4.9938	4.9722
util living area	0.9991	0.9975	0.9918	0.9674	0.8877	0.7232	0.5555	0.6262	0.8773	0.9853	0.9980	0.9994 (86)
MIT	19.6278	19.7978	20.0767	20.4496	20.7668	20.9428	20.9878	20.9785	20.8403	20.4204	19.9574	19.6043 (87)
Th 2	19.9369	19.9397	19.9424	19.9552	19.9576	19.9688	19.9688	19.9709	19.9645	19.9576	19.9528	19.9477 (88)
util rest of house												
	0.9988	0.9966	0.9887	0.9544	0.8442	0.6316	0.4328	0.5001	0.8125	0.9774	0.9971	0.9992 (89)
MIT 2	18.0984	18.3489	18.7569	19.3002	19.7258	19.9304	19.9643	19.9619	19.8307	19.2675	18.5919	18.0716 (90)
Living area fraction									fLA =	Living area / (4) =		0.1087 (91)
MIT	18.2645	18.5063	18.9003	19.4251	19.8389	20.0404	20.0755	20.0723	19.9404	19.3928	18.7402	18.2381 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2645	18.5063	18.9003	19.4251	19.8389	20.0404	20.0755	20.0723	19.9404	19.3928	18.7402	18.2381 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9980	0.9948	0.9843	0.9457	0.8383	0.6386	0.4460	0.5132	0.8106	0.9711	0.9956	0.9986 (94)
Useful gains	683.5480	827.8245	967.6889	1086.8075	1064.9995	807.7725	536.6443	560.9821	783.8937	784.8040	681.6951	639.6503 (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												
	2253.1499	2188.9108	1989.1460	1665.4114	1284.5281	848.3192	541.9342	571.3333	914.9449	1387.7259	1846.7224	2239.2445 (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												
	1167.7839	914.6500	759.9641	416.5948	163.3293	0.0000	0.0000	0.0000	0.0000	448.5739	838.8197	1190.0981 (98)
Space heating												5899.8137 (98)
Space heating per m2												(98) / (4) = 43.1084 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

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													6316.7170 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1167.7839	914.6500	759.9641	416.5948	163.3293	0.0000	0.0000	0.0000	0.0000	448.5739	838.8197	1190.0981	(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)	1250.3039	979.2827	813.6660	446.0330	174.8707	0.0000	0.0000	0.0000	0.0000	480.2718	898.0939	1274.1949	(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	219.5224	193.4541	203.0901	181.9467	176.7610	155.6813	149.1545	166.2723	167.4842	188.6737	199.6415	214.2037	(64)
Efficiency of water heater (217)m	88.6359	88.4576	88.0642	87.0709	84.8529	80.3000	80.3000	80.3000	80.3000	87.1544	88.2657	80.3000	(216)
Fuel for water heating, kWh/month	247.6676	218.6970	230.6160	208.9639	208.3146	193.8745	185.7466	207.0639	208.5731	216.4821	226.1824	241.4970	(219)
Water heating fuel used												2593.6789	(219)
Annual totals kWh/year													
Space heating fuel - main system												6316.7170	(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)												487.0571	(232)
Total delivered energy for all uses												9472.4530	(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	6316.7170	0.2160	1364.4109	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2593.6789	0.2160	560.2346	(264)
Space and water heating			1924.6455	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	487.0571	0.5190	252.7826	(268)
Total CO2, kg/m2/year			2216.3532	(272)
Emissions per m2 for space and water heating			14.0629	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.8470	(272b)
Emissions per m2 for pumps and fans			0.2844	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0629 * 1.00) + 1.8470 + 0.2844, rounded to 2 d.p.			16.1900	(273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.1216 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.3221 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3221 (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	0.4107	0.4026	0.3946	0.3543	0.3463	0.3060	0.3060	0.2980	0.3221	0.3463	0.3624	0.3785 (22b)
Effective ac	0.5843	0.5811	0.5778	0.5628	0.5600	0.5468	0.5468	0.5444	0.5519	0.5600	0.5657	0.5716 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		84.5631		(33)
1F Timber			82.1600			9.0000	739.4400 (32c)
GF Masonry			28.3900			39.0000	1107.2100 (32c)
GF Timber			44.0200			9.0000	396.1800 (32c)
2F Timber			61.5000			9.0000	553.5000 (32c)
Internal Floor			85.7900			12.6000	1080.9540 (32d)
Internal Ceiling			85.7900			9.0000	772.1100 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16730.7660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 122.2473 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2314 (36)
Total fabric heat loss (33) + (36) = 92.7945 (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	63.4243	63.0689	62.7205	61.0840	60.7778	59.3524	59.3524	59.0885	59.9015	60.7778	61.3972	62.0447 (38)
Heat transfer coeff	156.2189	155.8634	155.5150	153.8785	153.5723	152.1470	152.1470	151.8830	152.6960	153.5723	154.1917	154.8393 (39)
Average = Sum(39)m / 12 =												153.8770 (39)
HLP	1.1415	1.1389	1.1363	1.1243	1.1221	1.1117	1.1117	1.1098	1.1157	1.1221	1.1266	1.1314 (40)
HLP (average)												1.1243 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9109 (42)
Average daily hot water use (litres/day)												103.3328 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content (annual)	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (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	35.8197	31.3282	32.3279	28.1842	27.0434	23.3364	21.6246	24.8146	25.1109	29.2644	31.9444	34.6895 (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	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5792	24.4956	19.9212	15.0816	11.2737	9.5177	10.2842	13.3678	17.9423	22.7818	26.5897	28.3457 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.8127	308.9861	300.9893	283.9650	262.4749	242.2773	228.7840	225.6106	233.6074	250.6317	272.1218	292.3194 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	48.1448	46.6193	43.4514	39.1448	36.3487	32.4117	29.0654	33.3529	34.8763	39.3339	44.3672	46.6257 (72)
Total internal gains	448.1995	446.7638	431.0247	404.8542	376.7601	350.8695	334.7964	338.9942	353.0888	379.4102	409.7415	433.9536 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast					2.2500	11.2829	0.4600	0.0000	0.7700		8.9919 (75)	
Southeast					10.1200	36.7938	0.4600	0.0000	0.7700		131.8876 (77)	
Southwest					2.3600	36.7938	0.4600	0.0000	0.7700		30.7564 (79)	
Northwest					5.2500	11.2829	0.4600	0.0000	0.7700		20.9812 (81)	
Northwest					5.6900	11.2829	0.4300	0.0000	0.7700		21.2566 (81)	
Northwest					0.5500	16.3666	0.7100	0.7000	1.0000		4.0264 (82)	
Solar gains	217.9002	389.6095	582.2256	804.0279	976.1714	1002.4111	952.5703	819.0210	658.2124	443.8376	264.3495	184.3080 (83)
Total gains	666.0997	836.3733	1013.2502	1208.8820	1352.9315	1353.2806	1287.3667	1158.0152	1011.3012	823.2478	674.0910	618.2617 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.7495	29.8174	29.8842	30.2020	30.2622	30.5457	30.5457	30.5988	30.4359	30.2622	30.1406	30.0146
alpha	2.9833	2.9878	2.9923	3.0135	3.0175	3.0364	3.0364	3.0399	3.0291	3.0175	3.0094	3.0010
util living area	0.9873	0.9747	0.9476	0.8841	0.7710	0.6185	0.4831	0.5441	0.7670	0.9295	0.9787	0.9897 (86)
MIT	18.7476	19.0427	19.5030	20.0796	20.5529	20.8407	20.9446	20.9201	20.6766	20.0339	19.2797	18.6965 (87)
Th 2	19.9671	19.9692	19.9713	19.9810	19.9828	19.9913	19.9913	19.9929	19.9880	19.9828	19.9791	19.9753 (88)
util rest of house	0.9849	0.9701	0.9378	0.8621	0.7275	0.5460	0.3855	0.4447	0.7060	0.9115	0.9741	0.9879 (89)
MIT 2	17.8992	18.1931	18.6478	19.2117	19.6486	19.8964	19.9683	19.9570	19.7727	19.1809	18.4378	17.8541 (90)
Living area fraction	fLA = Living area / (4) =											0.1087 (91)
MIT	17.9914	18.2854	18.7407	19.3060	19.7469	19.9990	20.0744	20.0616	19.8709	19.2736	18.5292	17.9456 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9914	18.2854	18.7407	19.3060	19.7469	19.9990	20.0744	20.0616	19.8709	19.2736	18.5292	17.9456 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9786	0.9599	0.9229	0.8447	0.7161	0.5466	0.3939	0.4519	0.6979	0.8955	0.9650	0.9825 (94)
Useful gains	651.8367	802.8533	935.1310	1021.1387	968.8486	739.6368	507.1412	523.3527	705.7742	737.1841	650.5041	607.4451 (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	2138.8501	2086.3007	1903.6146	1601.2562	1235.7762	821.4433	528.6148	556.1401	881.1882	1332.0264	1762.2926	2128.3665 (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	1106.3380	862.4767	720.5518	417.6846	198.5941	0.0000	0.0000	0.0000	0.0000	442.5627	800.4877	1131.5655 (98)
Space heating												5680.2611 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating per m2

(98) / (4) = 41.5042 (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	1430.1817	1125.8877	1154.3111	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8124	0.8683	0.8348	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1161.8293	977.6065	963.5651	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1696.6461	1617.2545	1469.6995	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	385.0681	475.8981	376.5640	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction												1237.5302	(104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000	(105)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	96.2670	118.9745	94.1410	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												309.3825	(107)
Space cooling per m2												2.2606	(108)
Energy for space heating												41.5042	(99)
Energy for space cooling												2.2606	(108)
Total												43.7647	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.8	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.1216 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3716 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3716 (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	0.4738	0.4645	0.4552	0.4088	0.3995	0.3530	0.3530	0.3437	0.3716	0.3995	0.4181	0.4366 (22b)
Effective ac	0.6122	0.6079	0.6036	0.5835	0.5798	0.5623	0.5623	0.5591	0.5690	0.5798	0.5874	0.5953 (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			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			25.6700	1.3258	34.0322		(27)
TER Room Window (Uw = 1.70)			0.5500	1.5918	0.8755		(27a)
FP McCann System			51.0700	0.1300	6.6391		(28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.1800	25.7292		(29a)
WTV	20.8500		20.8500	0.1800	3.7530		(29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.1800	0.6210		(29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.1300	3.2253		(30)
Bay Plane	1.2200		1.2200	0.1300	0.1586		(30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1300	1.4248		(30)
Dormer Roof	2.9900		2.9900	0.1300	0.3887		(30)
CTV	13.9300		13.9300	0.1300	1.8109		(30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	80.8083		(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)							14.0858 (36)
Total fabric heat loss						(33) + (36) =	94.8941 (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	66.4539	65.9808	65.5170	63.3389	62.9314	61.0344	61.0344	60.6831	61.7651	62.9314	63.7558	64.6177 (38)
Heat transfer coeff	161.3479	160.8748	160.4111	158.2330	157.8255	155.9284	155.9284	155.5771	156.6591	157.8255	158.6499	159.5118 (39)
Average = Sum(39)m / 12 =												158.2311 (39)
HLP	1.1789	1.1755	1.1721	1.1562	1.1532	1.1393	1.1393	1.1368	1.1447	1.1532	1.1592	1.1655 (40)
HLP (average)												1.1562 (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												2.9109 (42)
Average daily hot water use (litres/day)												103.3328 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)

FULL SAP CALCULATION PRINTOUT

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Energy conte	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Energy content (annual)										Total =	Sum (45)m =	1625.8273 (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	35.8197	31.3282	32.3279	28.1842	27.0434	23.3364	21.6246	24.8146	25.1109	29.2644	31.9444	34.6895 (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	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427	145.5427 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5792	24.4956	19.9212	15.0816	11.2737	9.5177	10.2842	13.3678	17.9423	22.7818	26.5897	28.3457 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.8127	308.9861	300.9893	283.9650	262.4749	242.2773	228.7840	225.6106	233.6074	250.6317	272.1218	292.3194 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543	37.5543 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	48.1448	46.6193	43.4514	39.1448	36.3487	32.4117	29.0654	33.3529	34.8763	39.3339	44.3672	46.6257 (72)
Total internal gains	448.1995	446.7638	431.0247	404.8542	376.7601	350.8695	334.7964	338.9942	353.0888	379.4102	409.7415	433.9536 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	2.2500	11.2829	0.6300	0.7000	0.7700	7.7585 (75)
Southeast	10.1200	36.7938	0.6300	0.7000	0.7700	113.7961 (77)
Southwest	2.3600	36.7938	0.6300	0.7000	0.7700	26.5374 (79)
Northwest	10.9400	11.2829	0.6300	0.7000	0.7700	37.7235 (81)
Northwest	0.5500	16.3666	0.6300	0.7000	1.0000	3.5727 (82)

Solar gains	189.3882	338.9729	507.4266	702.0751	853.4914	876.8809	833.1015	715.5905	574.1024	386.3878	229.8221	160.1511 (83)
Total gains	637.5877	785.7367	938.4512	1106.9292	1230.2515	1227.7504	1167.8979	1054.5847	927.1912	765.7980	639.5637	594.1048 (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	58.9048	59.0780	59.2488	60.0644	60.2195	60.9521	60.9521	61.0897	60.6678	60.2195	59.9065	59.5829
alpha	4.9270	4.9385	4.9499	5.0043	5.0146	5.0635	5.0635	5.0726	5.0445	5.0146	4.9938	4.9722
util living area	0.9994	0.9981	0.9933	0.9718	0.8979	0.7384	0.5704	0.6449	0.8915	0.9882	0.9985	0.9996 (86)
MIT	19.5956	19.7665	20.0474	20.4249	20.7510	20.9371	20.9863	20.9755	20.8253	20.3933	19.9268	19.5726 (87)
Th 2	19.9369	19.9397	19.9424	19.9552	19.9576	19.9688	19.9688	19.9709	19.9645	19.9576	19.9528	19.9477 (88)
util rest of house	0.9991	0.9974	0.9907	0.9603	0.8568	0.6473	0.4454	0.5169	0.8307	0.9818	0.9979	0.9994 (89)
MIT 2	18.6495	18.8223	19.1041	19.4848	19.7867	19.9396	19.9653	19.9638	19.8625	19.4604	18.9931	18.6351 (90)
Living area fraction	18.7523	18.9249	19.2066	19.5869	19.8915	20.0480	20.0763	20.0737	19.9671	19.5618	19.0945	18.7370 (92)
Temperature adjustment	18.7523	18.9249	19.2066	19.5869	19.8915	20.0480	20.0763	20.0737	19.9671	19.5618	19.0945	18.7370 (93)
adjusted MIT	18.7523	18.9249	19.2066	19.5869	19.8915	20.0480	20.0763	20.0737	19.9671	19.5618	19.0945	18.7370 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9988	0.9964	0.9883	0.9550	0.8537	0.6549	0.4590	0.5306	0.8309	0.9783	0.9971	0.9991 (94)
Ext temp.	636.8091	782.9326	927.4509	1057.1518	1050.2843	804.0866	536.0335	559.5460	770.4028	749.1898	637.7276	593.5979 (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	2331.8500	2256.2549	2038.2764	1691.0235	1292.8294	849.5007	542.0489	571.5444	919.1383	1414.3929	1902.9294	2318.8166 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating per m2	1261.1104	990.0726	826.4542	456.3876	180.4535	0.0000	0.0000	0.0000	0.0000	494.9111	910.9452	1283.5627 (98)
												6403.8974 (98)
												46.7916 (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
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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	1465.7272	1153.8704	1182.3861	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8577	0.9195	0.8852	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1257.1069	1060.9681	1046.6698	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1550.6447	1478.2891	1349.3359	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	211.3473	310.4868	225.1835	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									FC = cooled area / (4) =			747.0176	(104)
Intermittency factor (Table 10b)												1.0000	(105)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	52.8368	77.6217	56.2959	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2												186.7544	(107)
Energy for space heating												1.3646	(108)
Energy for space cooling												46.7916	(99)
Total												1.3646	(108)
Target Fabric Energy Efficiency (TFEE)												48.1562	(109)
												55.4	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (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) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.2005 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2005 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	84.5631	(33)
1F Timber						9.0000	739.4400 (32c)
GF Masonry						39.0000	1107.2100 (32c)
GF Timber						9.0000	396.1800 (32c)
2F Timber						9.0000	553.5000 (32c)
Internal Floor						12.6000	1080.9540 (32d)
Internal Ceiling						9.0000	772.1100 (32e)

Heat capacity Cm = Sum (A x k) (28)...(30) + (32) + (32a)...(32e) = 16730.7660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 122.2473 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2314 (36)
Total fabric heat loss (33) + (36) = 92.7945 (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	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705 (38)
Heat transfer coeff	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651 (39)
Average = Sum(39)m / 12 =												147.0651 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746 (40)
HLP (average)												1.0746 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9109 (42)											
Average daily hot water use (litres/day)	103.3328 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content (annual)	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Distribution loss (46)m = 0.15 x (45)m	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1611	12.7791	14.1217	13.6311	14.0532	13.5579	13.9837	14.0288	13.5964	14.0871	13.6736	14.1483 (61)
Total heat required for water heating calculated for each month	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (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	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	59.5876	52.2142	54.1140	47.5078	45.8283	39.9041	37.3321	42.3347	42.6903	49.3119	53.4019	57.8160 (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	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.9480	61.2390	49.8029	37.7040	28.1842	23.7943	25.7105	33.4195	44.8556	56.9545	66.4743	70.8643 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.4369	461.1732	449.2377	423.8283	391.7536	361.6079	341.4687	336.7323	348.6678	374.0772	406.1519	436.2977 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	80.0909	77.6996	72.7339	65.9831	61.5972	55.4224	50.1776	56.9015	59.2921	66.2795	74.1693	77.7096 (72)
Total internal gains	722.0688	716.7049	688.3676	644.1085	598.1281	557.4176	533.9499	543.6464	569.4087	613.9042	663.3887	701.4646 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				2.2500	12.9236		0.4600		0.0000		0.7700		10.2994 (75)
Southeast				10.1200	40.4699		0.4600		0.0000		0.7700		145.0646 (77)
Southwest				2.3600	40.4699		0.4600		0.0000		0.7700		33.8293 (79)
Northwest				5.2500	12.9236		0.4600		0.0000		0.7700		24.0320 (81)
Northwest				5.6900	12.9236		0.4300		0.0000		0.7700		24.3475 (81)
Northwest				0.5500	18.7850		0.7100		0.7000		1.0000		4.6214 (82)
Solar gains	242.1941	390.7885	579.8620	829.7847	984.4398	1082.7206	1017.4473	892.7897	712.2369	476.1821	301.2353	202.7464	(83)
Total gains	964.2630	1107.4934	1268.2296	1473.8932	1582.5679	1640.1382	1551.3972	1436.4360	1281.6455	1090.0864	964.6240	904.2111	(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	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012
alpha	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067
util living area	0.9615	0.9415	0.8950	0.7937	0.6356	0.4271	0.2892	0.3207	0.5882	0.8378	0.9371	0.9673 (86)
MIT	19.3369	19.5598	19.9805	20.4548	20.7989	20.9589	20.9915	20.9882	20.8832	20.4471	19.8121	19.2750 (87)
Th 2	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217 (88)
util rest of house	0.9549	0.9318	0.8773	0.7602	0.5797	0.3508	0.2000	0.2257	0.5102	0.8024	0.9246	0.9616 (89)
MIT 2	17.8232	18.1420	18.7382	19.3864	19.8228	19.9938	20.0187	20.0173	19.9263	19.3937	18.5094	17.7346 (90)
Living area fraction	17.9877	18.2961	18.8732	19.5025	19.9289	20.0986	20.1244	20.1228	20.0303	19.5082	18.6510	17.9020 (92)
MIT	17.9877	18.2961	18.8732	19.5025	19.9289	20.0986	20.1244	20.1228	20.0303	19.5082	18.6510	17.9020 (92)
Temperature adjustment	17.8377	18.1461	18.7232	19.3525	19.7789	19.9486	19.9744	19.9728	19.8803	19.3582	18.5010	-0.1500
adjusted MIT	17.8377	18.1461	18.7232	19.3525	19.7789	19.9486	19.9744	19.9728	19.8803	19.3582	18.5010	17.7520 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9340	0.9067	0.8480	0.7339	0.5647	0.3448	0.1956	0.2208	0.4980	0.7735	0.8983	0.9424	(94)
Useful gains	900.6509	1004.1192	1075.5216	1081.7367	893.6701	565.5936	303.5032	317.2038	638.2200	843.1425	866.4991	852.1348	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
Month fracti	1873.2641	1845.0888	1665.2492	1390.1264	996.9335	580.7084	305.0718	319.5383	688.3087	1140.9533	1544.3232	1860.6674	(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)
RHI space heating demand	723.6242	565.1316	438.7574	222.0406	76.8279	0.0000	0.0000	0.0000	0.0000	221.5713	488.0333	750.3482	(98)
												3486.3346	(98)
												3486	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (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) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.2005 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2005 (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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
Effective ac	0.5056	0.5006	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	84.5631	(33)
1F Timber						9.0000	739.4400 (32c)
GF Masonry						39.0000	1107.2100 (32c)
GF Timber						9.0000	396.1800 (32c)
2F Timber						9.0000	553.5000 (32c)
Internal Floor						12.6000	1080.9540 (32d)
Internal Ceiling						9.0000	772.1100 (32e)

Heat capacity Cm = Sum (A x k) (28)...(30) + (32) + (32a)...(32e) = 16730.7660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 122.2473 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2314 (36)
Total fabric heat loss (33) + (36) = 92.7945 (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	54.8824	54.3384	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705 (38)
Heat transfer coeff	147.6770	147.1329	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651 (39)
Average = Sum(39)m / 12 =												147.1217 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0790	1.0751	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746 (40)
HLP (average)												1.0750 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9109 (42)											
Average daily hot water use (litres/day)	103.3328 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Energy content (annual)	Total = Sum(45)m =											1625.8273 (45)
Distribution loss (46)m = 0.15 x (45)m	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1611	12.7791	14.1217	13.6311	14.0532	13.5579	13.9837	14.0288	13.5964	14.0871	13.6736	14.1483 (61)
Total heat required for water heating calculated for each month	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (62)
WWHRS	-53.2248	-46.8328	-47.7980	-39.3148	-36.4983	-30.1049	-25.4708	-30.8420	-31.7453	-39.2520	-45.4799	-51.4469 eq. (G10)
Total of WWHRS savings												-478.0106
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	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462 (64)
Heat gains from water heating, kWh/month	59.5876	52.2142	54.1140	47.5078	45.8283	39.9041	37.3321	42.3347	42.6903	49.3119	53.4019	57.8160 (65)
	Total per year (kWh/year) = Sum(64)m =											1313.6387 (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	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.9480	61.2390	49.8029	37.7040	28.1842	23.7943	25.7105	33.4195	44.8556	56.9545	66.4743	70.8643 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.4369	461.1732	449.2377	423.8283	391.7536	361.6079	341.4687	336.7323	348.6678	374.0772	406.1519	436.2977 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	80.0909	77.6996	72.7339	65.9831	61.5972	55.4224	50.1776	56.9015	59.2921	66.2795	74.1693	77.7096 (72)
Total internal gains	722.0688	716.7049	688.3676	644.1085	598.1281	557.4176	533.9499	543.6464	569.4087	613.9042	663.3887	701.4646 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d	Gains W		
Northeast				2.2500	11.2829	0.4600	0.0000		0.7700	8.9919 (75)		
Southeast				10.1200	36.7938	0.4600	0.0000		0.7700	131.8876 (77)		
Southwest				2.3600	36.7938	0.4600	0.0000		0.7700	30.7564 (79)		
Northwest				5.2500	11.2829	0.4600	0.0000		0.7700	20.9812 (81)		
Northwest				5.6900	11.2829	0.4300	0.0000		0.7700	21.2566 (81)		
Northwest				0.5500	16.3666	0.7100	0.7000		1.0000	4.0264 (82)		
Solar gains	217.9002	389.6095	582.2256	804.0279	976.1714	1002.4111	952.5703	819.0210	658.2124	443.8376	264.3495	184.3080 (83)
Total gains	939.9690	1106.3145	1270.5931	1448.1363	1574.2995	1559.8287	1486.5202	1362.6674	1227.6210	1057.7418	927.7382	885.7726 (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	31.4703	31.5866	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012
alpha	3.0980	3.1058	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067
util living area	0.9682	0.9476	0.9081	0.8281	0.7010	0.5464	0.4161	0.4664	0.6804	0.8743	0.9512	0.9731 (86)
MIT	19.1687	19.4441	19.8468	20.3161	20.6886	20.8953	20.9664	20.9517	20.7885	20.2873	19.6309	19.1041 (87)
Th 2	20.0180	20.0213	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217 (88)
util rest of house	0.9629	0.9391	0.8933	0.8004	0.6546	0.4780	0.3307	0.3777	0.6155	0.8474	0.9418	0.9686 (89)
MIT 2	17.5772	17.9747	18.5483	19.1992	19.6880	19.9323	20.0016	19.9908	19.8228	19.1771	18.2497	17.4863 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.7501	18.1343	18.6894	19.3205	19.7967	20.0370	20.1064	20.0952	19.9277	19.2977	18.3997	17.6621 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6001	17.9843	18.5394	19.1705	19.6467	19.8870	19.9564	19.9452	19.7777	19.1477	18.2497	17.5121 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9441	0.9151	0.8646	0.7722	0.6350	0.4680	0.3248	0.3704	0.5975	0.8174	0.9181	0.9515	(94)
Useful gains	887.4273	1012.4403	1098.5844	1118.2335	999.6169	729.9622	482.7606	504.7771	733.4970	864.5940	851.7549	842.8451	(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													
Month fracti	1964.1169	1925.1371	1770.5700	1510.4372	1168.6800	777.5271	493.6091	521.3697	834.9900	1257.0706	1639.7360	1957.7399	(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	801.0571	613.3323	499.9573	282.3866	125.7829	0.0000	0.0000	0.0000	0.0000	292.0026	567.3463	829.4817	(98)
Space heating per m2												4011.3468	(98)
												(98) / (4) =	29.3099 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4432.4274	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	801.0571	613.3323	499.9573	282.3866	125.7829	0.0000	0.0000	0.0000	0.0000	292.0026	567.3463	829.4817	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	885.1459	677.7152	552.4390	312.0294	138.9867	0.0000	0.0000	0.0000	0.0000	322.6548	626.9020	916.5544	(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	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462	(64)
Efficiency of water heater (217)m	90.0407	89.9854	89.8690	89.5978	89.0169	87.3000	87.3000	87.3000	87.3000	89.5864	89.9304	87.3000	(216)
Fuel for water heating, kWh/month	143.8236	125.9904	131.8083	119.3645	117.7509	106.8402	103.4087	114.5032	114.5707	125.6327	131.7909	139.8396	(219)
Water heating fuel used												1475.3237	(219)
Annual totals kWh/year													
Space heating fuel - main system												4432.4274	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)		
mechanical ventilation fans (SFP = 0.2294)	92.0650	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	167.0650	(231)
Electricity for lighting (calculated in Appendix L)	487.0571	(232)
Total delivered energy for all uses	6561.8733	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4432.4274	3.4800	154.2485	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1475.3237	3.4800	51.3413	(247)
Mechanical ventilation fans	92.0650	13.1900	12.1434	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	487.0571	13.1900	64.2428	(250)
Additional standing charges			120.0000	(251)
Total energy cost			411.8685	(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] =	0.9512	(257)
SAP value		86.7308	
SAP rating (Section 12)		87	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4432.4274	0.2160	957.4043	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1475.3237	0.2160	318.6699	(264)
Space and water heating			1276.0742	(265)
Pumps and fans	167.0650	0.5190	86.7068	(267)

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Energy for lighting	487.0571	0.5190	252.7826 (268)
Total kg/year			1615.5636 (272)
CO2 emissions per m2			11.8000 (273)
EI value			88.0960
EI rating			88 (274)
EI band			B

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

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8894 = 3.913$, stars = 5
Water heating environmental impact	$0.216 / 0.8894 = 0.2429$, stars = 5

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (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) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.2005 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2005 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	84.5631	(33)
1F Timber						9.0000	739.4400 (32c)
GF Masonry						39.0000	1107.2100 (32c)
GF Timber						9.0000	396.1800 (32c)
2F Timber						9.0000	553.5000 (32c)
Internal Floor						12.6000	1080.9540 (32d)
Internal Ceiling						9.0000	772.1100 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16730.7660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							122.2473 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.2314 (36)
Total fabric heat loss					(33) + (36) =		92.7945 (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	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705 (38)
Heat transfer coeff	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651 (39)
Average = Sum(39)m / 12 =												147.0651 (39)
HLP	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746 (40)
HLP (average)												1.0746 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9109 (42)											
Average daily hot water use (litres/day)	103.3328 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content (annual)	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Distribution loss (46)m = 0.15 x (45)m	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1611	12.7791	14.1217	13.6311	14.0532	13.5579	13.9837	14.0288	13.5964	14.0871	13.6736	14.1483 (61)
Total heat required for water heating calculated for each month	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (62)
WWHRS	-53.2248	-46.8328	-47.7980	-39.3148	-36.4983	-30.1049	-25.4708	-30.8420	-31.7453	-39.2520	-45.4799	-51.4469 eq. (G10)
Total of WWHRS savings												-478.0106
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	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462 (64)
Heat gains from water heating, kWh/month	59.5876	52.2142	54.1140	47.5078	45.8283	39.9041	37.3321	42.3347	42.6903	49.3119	53.4019	57.8160 (65)
	Total per year (kWh/year) = Sum (64)m = 1313.6387 (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	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.9480	61.2390	49.8029	37.7040	28.1842	23.7943	25.7105	33.4195	44.8556	56.9545	66.4743	70.8643 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.4369	461.1732	449.2377	423.8283	391.7536	361.6079	341.4687	336.7323	348.6678	374.0772	406.1519	436.2977 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	80.0909	77.6996	72.7339	65.9831	61.5972	55.4224	50.1776	56.9015	59.2921	66.2795	74.1693	77.7096 (72)
Total internal gains	722.0688	716.7049	688.3676	644.1085	598.1281	557.4176	533.9499	543.6464	569.4087	613.9042	663.3887	701.4646 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
Northeast				2.2500	12.9236	0.4600	0.0000		0.7700		10.2994 (75)	
Southeast				10.1200	40.4699	0.4600	0.0000		0.7700		145.0646 (77)	
Southwest				2.3600	40.4699	0.4600	0.0000		0.7700		33.8293 (79)	
Northwest				5.2500	12.9236	0.4600	0.0000		0.7700		24.0320 (81)	
Northwest				5.6900	12.9236	0.4300	0.0000		0.7700		24.3475 (81)	
Northwest				0.5500	18.7850	0.7100	0.7000		1.0000		4.6214 (82)	
Solar gains	242.1941	390.7885	579.8620	829.7847	984.4398	1082.7206	1017.4473	892.7897	712.2369	476.1821	301.2353	202.7464 (83)
Total gains	964.2630	1107.4934	1268.2296	1473.8932	1582.5679	1640.1382	1551.3972	1436.4360	1281.6455	1090.0864	964.6240	904.2111 (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	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012
alpha	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067
util living area	0.9615	0.9415	0.8950	0.7937	0.6356	0.4271	0.2892	0.3207	0.5882	0.8378	0.9371	0.9673 (86)
MIT	19.3369	19.5598	19.9805	20.4548	20.7989	20.9589	20.9915	20.9882	20.8832	20.4471	19.8121	19.2750 (87)
Th 2	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217 (88)
util rest of house	0.9549	0.9318	0.8773	0.7602	0.5797	0.3508	0.2000	0.2257	0.5102	0.8024	0.9246	0.9616 (89)
MIT 2	17.8232	18.1420	18.7382	19.3864	19.8228	19.9938	20.0187	20.0173	19.9263	19.3937	18.5094	17.7346 (90)
Living area fraction	fLA = Living area / (4) = 0.1087 (91)											
MIT	17.9877	18.2961	18.8732	19.5025	19.9289	20.0986	20.1244	20.1228	20.0303	19.5082	18.6510	17.9020 (92)
Temperature adjustment	-0.1500											
adjusted MIT	17.8377	18.1461	18.7232	19.3525	19.7789	19.9486	19.9744	19.9728	19.8803	19.3582	18.5010	17.7520 (93)

8. Space heating requirement

AES
Sustainability
Consultants

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9340	0.9067	0.8480	0.7339	0.5647	0.3448	0.1956	0.2208	0.4980	0.7735	0.8983	0.9424 (94)
Useful gains	900.6509	1004.1192	1075.5216	1081.7367	893.6701	565.5936	303.5032	317.2038	638.2200	843.1425	866.4991	852.1348 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1873.2641	1845.0888	1665.2492	1390.1264	996.9335	580.7084	305.0718	319.5383	688.3087	1140.9533	1544.3232	1860.6674 (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	723.6242	565.1316	438.7574	222.0406	76.8279	0.0000	0.0000	0.0000	0.0000	221.5713	488.0333	750.3482 (98)
Space heating												3486.3346 (98)
Space heating per m2												25.4737 (99)
										(98) / (4) =		

Not applicable

Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)	
mechanical ventilation fans (SFP = 0.2294)	92.0650 (230a)
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	167.0650 (231)
Electricity for lighting (calculated in Appendix L)	487.0571 (232)
Total delivered energv for all uses	5983.1423 (238)

	Fuel	Fuel price	Fuel cost
	kWh/year	p/kWh	£/year
Space heating - main system 1	3652.3034	3.9200	151.0103 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1476.7167	3.9200	57.8873 (247)
Mechanical ventilation fans	92.0650	16.9600	15.6142 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	487.0571	16.9600	82.6049 (250)
Additional standing charges			88.0000 (251)
Total energy cost			407.8367 (255)

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3852.3034	0.2160	832.0975 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1476.7167	0.2160	318.9708 (264)
Space and water heating			1151.0683 (265)
Pumps and fans	167.0650	0.5190	86.7068 (267)
Energy for lighting	487.0571	0.5190	252.7826 (268)
Total kg/year			1490.5577 (272)

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	3852.3034	1.2200	4699.8102 (261)

Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1476.7167	1.2200	1801.5944 (264)
Space and water heating			6501.4045 (265)
Pumps and fans	167.0650	3.0700	512.8897 (267)
Energy for lighting	487.0571	3.0700	1495.2654 (268)
Primary energy kWh/year			8509.5595 (272)
Primary energy kWh/m2/year			62.1771 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 88

(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	SAP increase too small
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 7.3	-£ 309	-947 kg (63.5%)
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.7	-£ 23	-146 kg (9.8%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar photovoltaic panels	£309	6.92 kg/m ²	A 94 A 95
Total Savings	£309	6.92 kg/m ²	

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£111	£111	£0
Mains gas	£297	£297	£0
Space heating	£267	£267	£0
Water heating	£58	£58	£0
Lighting	£83	£83	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£408	£99	£309
Total cost of uses	£408	£99	£309
Delivered energy	44 kWh/m ²	30 kWh/m ²	13 kWh/m ²
Carbon dioxide emissions	1.5 tonnes	0.5 tonnes	0.9 tonnes
CO2 emissions per m ²	11 kg/m ²	4 kg/m ²	7 kg/m ²
Primary energy	62 kWh/m ²	21 kWh/m ²	41 kWh/m ²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (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) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.2005 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2005 (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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
Effective ac	0.5056	0.5006	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	84.5631	(33)
1F Timber						9.0000	739.4400 (32c)
GF Masonry						39.0000	1107.2100 (32c)
GF Timber						9.0000	396.1800 (32c)
2F Timber						9.0000	553.5000 (32c)
Internal Floor						12.6000	1080.9540 (32d)
Internal Ceiling						9.0000	772.1100 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16730.7660 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 122.2473 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2314 (36)
Total fabric heat loss (33) + (36) = 92.7945 (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	54.8824	54.3384	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705 (38)
Heat transfer coeff	147.6770	147.1329	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651 (39)
Average = Sum(39)m / 12 =												147.1217 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0790	1.0751	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746 (40)
HLP (average)												1.0750 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9109 (42)											
Average daily hot water use (litres/day)	103.3328 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content (annual)	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Distribution loss (46)m = 0.15 x (45)m	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1611	12.7791	14.1217	13.6311	14.0532	13.5579	13.9837	14.0288	13.5964	14.0871	13.6736	14.1483 (61)
Total heat required for water heating calculated for each month	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (62)
WWHRS	-53.2248	-46.8328	-47.7980	-39.3148	-36.4983	-30.1049	-25.4708	-30.8420	-31.7453	-39.2520	-45.4799	-51.4469 eq. (G10)
Total of WWHRS savings												-478.0106
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	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462 (64)
Heat gains from water heating, kWh/month	59.5876	52.2142	54.1140	47.5078	45.8283	39.9041	37.3321	42.3347	42.6903	49.3119	53.4019	57.8160 (65)
												1313.6387 (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	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.9480	61.2390	49.8029	37.7040	28.1842	23.7943	25.7105	33.4195	44.8556	56.9545	66.4743	70.8643 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.4369	461.1732	449.2377	423.8283	391.7536	361.6079	341.4687	336.7323	348.6678	374.0772	406.1519	436.2977 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	80.0909	77.6996	72.7339	65.9831	61.5972	55.4224	50.1776	56.9015	59.2921	66.2795	74.1693	77.7096 (72)
Total internal gains	722.0688	716.7049	688.3676	644.1085	598.1281	557.4176	533.9499	543.6464	569.4087	613.9042	663.3887	701.4646 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d	Gains W		
Northeast				2.2500	11.2829	0.4600	0.0000		0.7700	8.9919 (75)		
Southeast				10.1200	36.7938	0.4600	0.0000		0.7700	131.8876 (77)		
Southwest				2.3600	36.7938	0.4600	0.0000		0.7700	30.7564 (79)		
Northwest				5.2500	11.2829	0.4600	0.0000		0.7700	20.9812 (81)		
Northwest				5.6900	11.2829	0.4300	0.0000		0.7700	21.2566 (81)		
Northwest				0.5500	16.3666	0.7100	0.7000		1.0000	4.0264 (82)		
Solar gains	217.9002	389.6095	582.2256	804.0279	976.1714	1002.4111	952.5703	819.0210	658.2124	443.8376	264.3495	184.3080 (83)
Total gains	939.9690	1106.3145	1270.5931	1448.1363	1574.2995	1559.8287	1486.5202	1362.6674	1227.6210	1057.7418	927.7382	885.7726 (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	31.4703	31.5866	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012
alpha	3.0980	3.1058	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067
util living area	0.9682	0.9476	0.9081	0.8281	0.7010	0.5464	0.4161	0.4664	0.6804	0.8743	0.9512	0.9731 (86)
MIT	19.1687	19.4441	19.8468	20.3161	20.6886	20.8953	20.9664	20.9517	20.7885	20.2873	19.6309	19.1041 (87)
Th 2	20.0180	20.0213	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217 (88)
util rest of house	0.9629	0.9391	0.8933	0.8004	0.6546	0.4780	0.3307	0.3777	0.6155	0.8474	0.9418	0.9686 (89)
MIT 2	17.5772	17.9747	18.5483	19.1992	19.6880	19.9323	20.0016	19.9908	19.8228	19.1771	18.2497	17.4863 (90)
Living area fraction	17.7501	18.1343	18.6894	19.3205	19.7967	20.0370	20.1064	20.0952	19.9277	19.2977	18.3997	17.6621 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6001	17.9843	18.5394	19.1705	19.6467	19.8870	19.9564	19.9452	19.7777	19.1477	18.2497	17.5121 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9441	0.9151	0.8646	0.7722	0.6350	0.4680	0.3248	0.3704	0.5975	0.8174	0.9181	0.9515	(94)
Useful gains	887.4273	1012.4403	1098.5844	1118.2335	999.6169	729.9622	482.7606	504.7771	733.4970	864.5940	851.7549	842.8451	(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													
1964.1169	1925.1371	1770.5700	1510.4372	1168.6800	777.5271	493.6091	521.3697	834.9900	1257.0706	1639.7360	1957.7399	1957.7399	(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													
801.0571	613.3323	499.9573	282.3866	125.7829	0.0000	0.0000	0.0000	0.0000	292.0026	567.3463	829.4817	829.4817	(98)
Space heating per m2													
											(98) / (4) =	29.3099	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4432.4274	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	801.0571	613.3323	499.9573	282.3866	125.7829	0.0000	0.0000	0.0000	0.0000	292.0026	567.3463	829.4817	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	885.1459	677.7152	552.4390	312.0294	138.9867	0.0000	0.0000	0.0000	0.0000	322.6548	626.9020	916.5544	(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	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462	(64)
Efficiency of water heater (217)m	90.0407	89.9854	89.8690	89.5978	89.0169	87.3000	87.3000	87.3000	87.3000	89.5864	89.9304	87.3000	(216)
Fuel for water heating, kWh/month	143.8236	125.9904	131.8083	119.3645	117.7509	106.8402	103.4087	114.5032	114.5707	125.6327	131.7909	139.8396	(219)
Water heating fuel used												1475.3237	(219)
Annual totals kWh/year													
Space heating fuel - main system												4432.4274	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)		
mechanical ventilation fans (SFP = 0.2294)		92.0650 (230a)
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
Total electricity for the above, kWh/year		167.0650 (231)
Electricity for lighting (calculated in Appendix L)		487.0571 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	-1727.2394 (233)
Total delivered energy for all uses		4834.6339 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4432.4274	3.4800	154.2485	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1475.3237	3.4800	51.3413	(247)
Mechanical ventilation fans	92.0650	13.1900	12.1434	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	487.0571	13.1900	64.2428	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			184.0456	(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] =	0.4250 (257)
SAP value		94.0706
SAP rating (Section 12)		94 (258)
SAP band		A

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

Energy	Emission factor	Emissions
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	4432.4274	0.2160	957.4043 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1475.3237	0.2160	318.6699 (264)
Space and water heating			1276.0742 (265)
Pumps and fans	167.0650	0.5190	86.7068 (267)
Energy for lighting	487.0571	0.5190	252.7826 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			719.1264 (272)
CO2 emissions per m2			5.2500 (273)
EI value			94.7013
EI rating			95 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	51.0700 (1b)	x 2.3100 (2b)	= 117.9717 (1b) - (3b)
First floor	49.8600 (1c)	x 2.5300 (2c)	= 126.1458 (1c) - (3c)
Second floor	35.9300 (1d)	x 2.3600 (2d)	= 84.7948 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.8600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 328.9123 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (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) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.2005 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2005 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Window (Uw = 1.20)			19.9800	1.1450	22.8779		(27)
French Door (Uw = 1.40)			5.6900	1.3258	7.5436		(27)
Front Door			2.1500	1.0000	2.1500		(26)
Rooflights (Uw = 1.80)			0.5500	1.6791	0.9235		(27a)
FP McCann System			51.0700	0.1100	5.6177	75.0000	3830.2500 (28a)
100mm Knauf Supafil 34	168.4500	25.5100	142.9400	0.2500	35.7350	52.8000	7547.2320 (29a)
WTV	20.8500		20.8500	0.1200	2.5020	9.0000	187.6500 (29a)
Dormer Cheek	5.7600	2.3100	3.4500	0.2800	0.9660	9.0000	31.0500 (29a)
Plane Ceiling-500mm Loft Roll	24.8100		24.8100	0.0900	2.2329	9.0000	223.2900 (30)
Bay Plane	1.2200		1.2200	0.1400	0.1708	9.0000	10.9800 (30)
Sloping Ceiling	11.5100	0.5500	10.9600	0.1600	1.7536	9.0000	98.6400 (30)
Dormer Roof	2.9900		2.9900	0.1400	0.4186	9.0000	26.9100 (30)
CTV	13.9300		13.9300	0.1200	1.6716	9.0000	125.3700 (30)
Total net area of external elements Aum(A, m ²)			300.5900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	84.5631	(33)
1F Timber						9.0000	739.4400 (32c)
GF Masonry						39.0000	1107.2100 (32c)
GF Timber						9.0000	396.1800 (32c)
2F Timber						9.0000	553.5000 (32c)
Internal Floor						12.6000	1080.9540 (32d)
Internal Ceiling						9.0000	772.1100 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16730.7660 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 122.2473 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2314 (36)
 Total fabric heat loss (33) + (36) = 92.7945 (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	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705	54.2705 (38)
Heat transfer coeff	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651	147.0651 (39)
Average = Sum(39)m / 12 =												147.0651 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746	1.0746 (40)
HLP (average)												1.0746 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9109 (42)											
Average daily hot water use (litres/day)	103.3328 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6661	109.5328	105.3995	101.2661	97.1328	92.9995	92.9995	97.1328	101.2661	105.3995	109.5328	113.6661 (44)
Energy content	168.5635	147.4267	152.1312	132.6316	127.2632	109.8185	101.7630	116.7745	118.1691	137.7148	150.3264	163.2448 (45)
Energy content (annual)	Total = Sum(45)m =											1625.8273 (45)
Distribution loss (46)m = 0.15 x (45)m	25.2845	22.1140	22.8197	19.8947	19.0895	16.4728	15.2644	17.5162	17.7254	20.6572	22.5490	24.4867 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1611	12.7791	14.1217	13.6311	14.0532	13.5579	13.9837	14.0288	13.5964	14.0871	13.6736	14.1483 (61)
Total heat required for water heating calculated for each month	182.7246	160.2058	166.2528	146.2628	141.3165	123.3764	115.7467	130.8033	131.7656	151.8018	164.0000	177.3931 (62)
WWHRS	-53.2248	-46.8328	-47.7980	-39.3148	-36.4983	-30.1049	-25.4708	-30.8420	-31.7453	-39.2520	-45.4799	-51.4469 eq. (G10)
Total of WWHRS savings												-478.0106
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	129.4998	113.3730	118.4549	106.9480	104.8181	93.2715	90.2758	99.9613	100.0203	112.5498	118.5201	125.9462 (64)
Heat gains from water heating, kWh/month	59.5876	52.2142	54.1140	47.5078	45.8283	39.9041	37.3321	42.3347	42.6903	49.3119	53.4019	57.8160 (65)
Total per year (kWh/year) = Sum(64)m =												1313.6387 (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	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513	174.6513 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.9480	61.2390	49.8029	37.7040	28.1842	23.7943	25.7105	33.4195	44.8556	56.9545	66.4743	70.8643 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.4369	461.1732	449.2377	423.8283	391.7536	361.6079	341.4687	336.7323	348.6678	374.0772	406.1519	436.2977 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760	55.3760 (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)	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342	-116.4342 (71)
Water heating gains (Table 5)	80.0909	77.6996	72.7339	65.9831	61.5972	55.4224	50.1776	56.9015	59.2921	66.2795	74.1693	77.7096 (72)
Total internal gains	722.0688	716.7049	688.3676	644.1085	598.1281	557.4176	533.9499	543.6464	569.4087	613.9042	663.3887	701.4646 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				2.2500	12.9236	0.4600	0.0000	0.7700	10.2994 (75)			
Southeast				10.1200	40.4699	0.4600	0.0000	0.7700	145.0646 (77)			
Southwest				2.3600	40.4699	0.4600	0.0000	0.7700	33.8293 (79)			
Northwest				5.2500	12.9236	0.4600	0.0000	0.7700	24.0320 (81)			
Northwest				5.6900	12.9236	0.4300	0.0000	0.7700	24.3475 (81)			
Northwest				0.5500	18.7850	0.7100	0.7000	1.0000	4.6214 (82)			
Solar gains	242.1941	390.7885	579.8620	829.7847	984.4398	1082.7206	1017.4473	892.7897	712.2369	476.1821	301.2353	202.7464 (83)
Total gains	964.2630	1107.4934	1268.2296	1473.8932	1582.5679	1640.1382	1551.3972	1436.4360	1281.6455	1090.0864	964.6240	904.2111 (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	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012	31.6012
alpha	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067	3.1067
util living area	0.9615	0.9415	0.8950	0.7937	0.6356	0.4271	0.2892	0.3207	0.5882	0.8378	0.9371	0.9673 (86)
MIT	19.3369	19.5598	19.9805	20.4548	20.7989	20.9589	20.9915	20.9882	20.8832	20.4471	19.8121	19.2750 (87)
Th 2	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217	20.0217 (88)
util rest of house	0.9549	0.9318	0.8773	0.7602	0.5797	0.3508	0.2000	0.2257	0.5102	0.8024	0.9246	0.9616 (89)
MIT 2	17.8232	18.1420	18.7382	19.3864	19.8228	19.9938	20.0187	20.0173	19.9263	19.3937	18.5094	17.7346 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.9877	18.2961	18.8732	19.5025	19.9289	20.0986	20.1244	20.1228	20.0303	19.5082	18.6510	17.9020 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8377	18.1461	18.7232	19.3525	19.7789	19.9486	19.9744	19.9728	19.8803	19.3582	18.5010	17.7520 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9340	0.9067	0.8480	0.7339	0.5647	0.3448	0.1956	0.2208	0.4980	0.7735	0.8983	0.9424 (94)
Useful gains	900.6509	1004.1192	1075.5216	1081.7367	893.6701	565.5936	303.5032	317.2038	638.2200	843.1425	866.4991	852.1348 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1873.2641	1845.0888	1665.2492	1390.1264	996.9335	580.7084	305.0718	319.5383	688.3087	1140.9533	1544.3232	1860.6674 (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	723.6242	565.1316	438.7574	222.0406	76.8279	0.0000	0.0000	0.0000	0.0000	221.5713	488.0333	750.3482 (98)
Space heating												3486.3346 (98)
Space heating per m2											(98) / (4) =	25.4737 (99)

Not applicable

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3852.3034	0.2160	832.0976 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (261)
Water heating (other fuel)	1476.7167	0.2160	318.9708 (264)
Space and water heating			1151.0683 (265)
Pumps and fans	167.0650	0.5190	86.7068 (267)
Energy for lighting	487.0571	0.5190	252.7826 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			543.8189 (272)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3852.3034	1.2200	4699.8102 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1476.7167	1.2200	1801.5944 (264)
Space and water heating			6501.4045 (265)
Pumps and fans	167.0650	3.0700	512.8897 (267)
Energy for lighting	487.0571	3.0700	1495.2654 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			2909.3895 (272)
Primary energy kWh/m2/year			21.2581 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	122.2 (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	434.16 (P1)
Transmission heat loss coefficient	92.79 (37)
Summer heat loss coefficient	526.96 (P2)

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

Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	2.2500	98.8453	0.4600	0.0000	0.9000	92.0744
South East	10.1200	119.9223	0.4600	0.0000	0.9000	502.4363
South West	2.3600	119.9223	0.4600	0.0000	0.9000	117.1689
North West	5.2500	98.8453	0.4600	0.0000	0.9000	214.8402
North West	5.6900	98.8453	0.4300	0.0000	0.9000	217.6602
North West	0.5500	156.6480	0.7100	0.7000	1.0000	38.5378

total: 1182.7178

	Jun	Jul	Aug	
Solar gains	1258	1183	1038	(P3/P4)
Internal gains	554	531	541	
Total summer gains	1813	1714	1579	(P5)
Summer gain/loss ratio	3.44	3.25	3.00	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 122.2)	1.14	1.14	1.14	
Threshold temperature	20.58	22.30	21.94	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			