

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	Allum Ens/Semi (ASHP+PV)			Issued on Date	15/12/2022
Assessment Reference	Allum End/Semi (ASHP+PV)	Prop Type Ref	Allum		
Property	4 Bed, WC, B, ES, 2.5 Storey				
SAP Rating	92 A	DER	9.01	TER	25.11
Environmental	93 A	% DER<TER	64.11		
CO ₂ Emissions (t/year)	0.71	DFEE	42.56	TFEE	53.25
General Requirements Compliance	Pass	% DFEE<TFEE	20.08		
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

Semi-Detached House, total floor area 104 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:Electricity

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 25.11 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 9.01 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.2 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)42.6 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	1.26 (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: Heat pump with radiators or underfloor - Electric

Vaillant aroTHERM 8kW VWL 85/3 A 230v

Secondary heating system: None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.56 kWh/day	
Permitted by DBSCG 2.24	OK	
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
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Hot water controls:

Cylinderstat	OK
Independent timer for DHW	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
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Based on:

Overshading:	Average
Windows facing North East:	7.67 m ² , No overhang
Windows facing South West:	6.93 m ² , No overhang
Air change rate:	4.00 ach
Blinds/curtains:	None

10 Key features

External wall U-value	0.12 W/m ² K
Party wall U-value	0.00 W/m ² K
Roof U-value	0.09 W/m ² K
Roof U-value	0.12 W/m ² K
Floor U-value	0.11 W/m ² K
Door U-value	1.00 W/m ² K
Window U-value	0.90 W/m ² K
Thermal bridging y-value	0.037 W/m ² K
Photovoltaic array	1.20 kW

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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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1855 (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	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179 (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
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.6003		(32)
E-WM-30			55.0100	0.0000	0.0000	45.0000	2475.4500 (32)
Timber GF			24.3200			9.0000	218.8800 (32c)
Timber 1F			84.5900			9.0000	761.3100 (32c)
Timber 2F			46.3400			9.0000	417.0600 (32c)
AAC GF			36.0400			39.0000	1405.5600 (32c)
Internal Floor			40.0200			12.6000	504.2520 (32d)
Internal Floor			23.7500			12.6000	299.2500 (32d)
Internal Ceiling			40.0200			9.0000	360.1800 (32e)
Internal Ceiling			23.7500			9.0000	213.7500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.7206 (36)
Total fabric heat loss (33) + (36) = 64.3209 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459 (38)
Heat transfer coeff	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669 (39)
Average = Sum(39)m / 12 =												106.5669 (39)
HLP	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268 (40)
HLP (average)												1.0268 (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	2.7719 (42)											
Average daily hot water use (litres/day)	100.0338 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy content	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (45)
Energy content (annual)	Total = Sum(45)m =											1573.9214 (45)
Distribution loss (46)m = 0.15 x (45)m	23.7050 (46)											
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
WWHRS	212.5588	187.3184	196.6511	176.1813	172.5770	154.0964	147.8909	162.4232	162.1805	182.6949	193.3111	207.4098 (62)
Total of WWHRS savings	-51.0124	-44.8851	-45.8106	-37.6867	-34.9903	-28.8634	-24.4248	-29.5739	-30.4381	-37.6310	-43.5953	-49.3069 eq. (G10)
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	161.5464	142.4333	150.8404	138.4946	137.5868	125.2330	123.4661	132.8493	131.7424	145.0639	149.7158	158.1030 (64)
Heat gains from water heating, kWh/month	93.7594	83.1331	88.4701	80.9193	80.4655	73.5761	72.2574	77.0894	76.2640	83.8297	86.6150	92.0474 (65)
	Total per year (kWh/year) = Sum(64)m =											1697.0749 (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	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.4561	21.7217	17.6653	13.3737	9.9970	8.4399	9.1196	11.8540	15.9104	20.2020	23.5787	25.1358 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.3132	265.0352	258.1759	243.5732	225.1399	207.8152	196.2413	193.5193	200.3786	214.9813	233.4146	250.7393 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597 (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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780 (71)
Water heating gains (Table 5)	126.0208	123.7100	118.9115	112.3879	108.1526	102.1890	97.1201	103.6147	105.9223	112.6743	120.2986	123.7197 (72)
Total internal gains	477.3693	475.0462	459.3319	433.9141	407.8688	383.0234	367.0603	373.5673	386.7906	412.4369	441.8711	464.1740 (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					4.3400	11.2829	0.4600	0.0000			0.7700	17.3445 (75)
Southwest					6.9300	36.7938	0.4600	0.0000			0.7700	90.3144 (79)
Northeast					3.3300	11.2829	0.4300	0.0000			0.7700	12.4402 (75)
Northeast					1.5000	16.8560	0.7100	0.7000			1.0000	11.3095 (82)

Solar gains	131.4085	237.9216	363.2692	513.8860	634.1917	655.4825	621.1788	527.4015	414.7580	273.0970	159.9541	110.8080 (83)
Total gains	608.7778	712.9678	822.6011	947.8001	1042.0605	1038.5059	988.2390	900.9688	801.5486	685.5338	601.8252	574.9819 (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	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407
alpha	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160
util living area	0.9863	0.9752	0.9494	0.8852	0.7633	0.5992	0.4571	0.5149	0.7484	0.9246	0.9768	0.9888 (86)
Tweekday	17.8426	18.1648	18.6808	19.2975	19.7687	19.9916	20.0475	20.0386	19.8838	19.2645	18.4260	17.7560
Tweekend	19.9316	20.0755	20.3076	20.5919	20.8227	20.9459	20.9844	20.9761	20.8773	20.5702	20.1906	19.8931
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.3512	19.5699	19.9314	20.3628	20.7264	20.9168	20.9760	20.9632	20.8084	20.3366	19.7361	19.2916 (87)
Th 2	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611 (88)
util rest of house	0.9836	0.9703	0.9394	0.8624	0.7183	0.5278	0.3665	0.4209	0.6848	0.9046	0.9714	0.9865 (89)
Tweekday	17.8426	18.1648	18.6808	19.2975	19.7687	19.9916	20.0475	20.0386	19.8838	19.2645	18.4260	17.7560

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Tweekend	17.8426	18.1648	18.6808	19.2975	19.7687	19.9916	20.0475	20.0386	19.8838	19.2645	18.4260	17.7560
MIT 2	17.8426	18.1648	18.6808	19.2975	19.7687	19.9916	20.0475	20.0386	19.8838	19.2645	18.4260	17.7560 (90)
Living area fraction									fLA = Living area / (4) =			0.2924 (91)
MIT	18.2837	18.5756	19.0465	19.6090	20.0487	20.2622	20.3190	20.3090	20.1542	19.5780	18.8091	18.2050 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2837	18.5756	19.0465	19.6090	20.0487	20.2622	20.3190	20.3090	20.1542	19.5780	18.8091	18.2050 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9764	0.9600	0.9257	0.8496	0.7177	0.5438	0.3921	0.4466	0.6917	0.8919	0.9616	0.9802 (94)
Useful gains	594.4046	684.4679	761.4612	805.2297	747.8872	564.7568	387.4722	402.4013	554.4256	611.4054	578.7209	563.6123 (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	1490.2029	1457.3701	1337.0428	1141.2226	889.6993	603.3994	396.3234	416.5669	645.1728	956.7559	1247.7999	1492.4716 (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	666.4739	519.3903	428.2327	241.9149	105.5082	0.0000	0.0000	0.0000	0.0000	256.9408	481.7369	691.0713 (98)
Space heating per m2										(98) / (4) =		32.6743 (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 %)												267.9464 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1265.6519 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	666.4739	519.3903	428.2327	241.9149	105.5082	0.0000	0.0000	0.0000	0.0000	256.9408	481.7369	691.0713 (98)
Space heating efficiency (main heating system 1)	267.9464	267.9464	267.9464	267.9464	267.9464	0.0000	0.0000	0.0000	0.0000	267.9464	267.9464	267.9464 (210)
Space heating fuel (main heating system)	248.7340	193.8411	159.8203	90.2848	39.3766	0.0000	0.0000	0.0000	0.0000	95.8926	179.7885	257.9140 (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												
Water heating requirement	161.5464	142.4333	150.8404	138.4946	137.5868	125.2330	123.4661	132.8493	131.7424	145.0639	149.7158	158.1030 (64)
Efficiency of water heater (217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800 (216)
Fuel for water heating, kWh/month	94.8710	83.6465	88.5837	81.3334	80.8003	73.5453	72.5077	78.0181	77.3681	85.1914	87.9233	92.8488 (219)
Water heating fuel used												996.6378 (219)
Annual totals kWh/year												
Space heating fuel - main system												1265.6519 (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)												71.6664 (230a)
Total electricity for the above, kWh/year												71.6664 (231)
Electricity for lighting (calculated in Appendix L)												431.9021 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.20 * 1004 * 1.00) =									-963.8364			-963.8364 (233)
Total delivered energy for all uses												1802.0219 (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	1265.6519	0.5190	656.8733 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	996.6378	0.5190	517.2550 (264)
Space and water heating			1174.1284 (265)
Pumps and fans	71.6664	0.5190	37.1949 (267)
Energy for lighting	431.9021	0.5190	224.1572 (268)
Energy saving/generation technologies			
PV Unit	-963.8364	0.5190	-500.2311 (269)
Total CO2, kg/year			935.2494 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.0100 (273)

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

DER			9.0100 ZC1
Total Floor Area		TFA	103.7900
Assumed number of occupants		N	2.7719
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			14.9765 ZC2
CO2 emissions from cooking, equation (L16)			1.7875 ZC3
Total CO2 emissions			25.7740 ZC4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	25.7740	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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) =	0.1562 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4062 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3758 (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	0.4791	0.4697	0.4603	0.4133	0.4039	0.3570	0.3570	0.3476	0.3758	0.4039	0.4227	0.4415 (22b)
Effective ac	0.6148	0.6103	0.6059	0.5854	0.5816	0.5637	0.5637	0.5604	0.5706	0.5816	0.5894	0.5975 (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)			14.6000	1.3258	19.3561		(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876		(27a)
FP McCann System			40.0200	0.1300	5.2026		(28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.1800	15.9426		(29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.1800	0.6030		(29a)
Wall to Void	17.8000		17.8000	0.1800	3.2040		(29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.1300	1.6380		(30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1300	1.2493		(30)
Dormer Flat Roof	2.6400		2.6400	0.1300	0.3432		(30)
Ceiling to Void	16.2700		16.2700	0.1300	2.1151		(30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.1915		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4812 (36)
Total fabric heat loss						(33) + (36) =	65.6727 (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	51.9427	51.5662	51.1971	49.4635	49.1392	47.6293	47.6293	47.3497	48.2109	49.1392	49.7953	50.4813 (38)
Heat transfer coeff	117.6154	117.2389	116.8698	115.1362	114.8119	113.3020	113.3020	113.0224	113.8836	114.8119	115.4680	116.1540 (39)
Average = Sum(39)m / 12 =												115.1347 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1332	1.1296	1.1260	1.1093	1.1062	1.0916	1.0916	1.0890	1.0973	1.1062	1.1125	1.1191 (40)
HLP (average)												1.1093 (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												2.7719 (42)
Average daily hot water use (litres/day)												100.0338 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy conte	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m = 1573.9214 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.4773	21.4080	22.0911	19.2596	18.4800	15.9469	14.7771	16.9570	17.1595	19.9977	21.8291	23.7050 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss												
	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage												
	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	214.1080	188.7177	198.2003	177.6806	174.1263	155.5957	149.4402	163.9724	163.6798	184.2442	194.8104	208.9591 (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												
	214.1080	188.7177	198.2003	177.6806	174.1263	155.5957	149.4402	163.9724	163.6798	184.2442	194.8104	208.9591 (64)
Heat gains from water heating, kWh/month												
	94.9989	84.2526	89.7095	82.1187	81.7049	74.7755	73.4968	78.3288	77.4635	85.0691	87.8144	93.2868 (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	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	24.4561	21.7217	17.6653	13.3737	9.9970	8.4399	9.1196	11.8540	15.9104	20.2020	23.5787	25.1358 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	262.3132	265.0352	258.1759	243.5732	225.1399	207.8152	196.2413	193.5193	200.3786	214.9813	233.4146	250.7393 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597 (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)												
	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780 (71)
Water heating gains (Table 5)												
	127.6866	125.3759	120.5773	114.0538	109.8185	103.8549	98.7860	105.2806	107.5882	114.3402	121.9645	125.3855 (72)
Total internal gains												
	482.0352	479.7120	463.9978	438.5800	412.5347	387.6893	371.7262	378.2332	391.4565	417.1027	446.5370	468.8399 (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	7.6700	11.2829	0.6300	0.7000	0.7700	26.4478 (75)
Southwest	6.9300	36.7938	0.6300	0.7000	0.7700	77.9256 (79)
Northeast	1.5000	16.8560	0.6300	0.7000	1.0000	10.0352 (82)

Solar gains	114.4086	207.3839	317.2513	449.7098	555.7326	574.6864	544.4922	461.8223	362.5271	238.2080	139.3052	96.4448 (83)
Total gains	596.4438	687.0959	781.2491	888.2898	968.2672	962.3757	916.2183	840.0555	753.9836	655.3107	585.8422	565.2847 (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	61.2814	61.4782	61.6724	62.6010	62.7778	63.6144	63.6144	63.7718	63.2895	62.7778	62.4211	62.0524
alpha	5.0854	5.0985	5.1115	5.1734	5.1852	5.2410	5.2410	5.2515	5.2193	5.1852	5.1614	5.1368
util living area	0.9984	0.9963	0.9896	0.9623	0.8764	0.7027	0.5337	0.5989	0.8560	0.9794	0.9965	0.9988 (86)
MIT	19.7577	19.9074	20.1625	20.5093	20.8001	20.9553	20.9912	20.9846	20.8718	20.4963	20.0696	19.7380 (87)
Th 2	19.9738	19.9768	19.9796	19.9932	19.9958	20.0077	20.0077	20.0099	20.0031	19.9958	19.9906	19.9852 (88)
util rest of house	0.9978	0.9950	0.9858	0.9479	0.8313	0.6136	0.4188	0.4800	0.7875	0.9690	0.9951	0.9984 (89)
MIT 2	18.3143	18.5349	18.9078	19.4122	19.7987	19.9779	20.0044	20.0035	19.8980	19.4029	18.7823	18.2937 (90)
Living area fraction												
MIT	18.7364	18.9362	19.2747	19.7330	20.0915	20.2637	20.2930	20.2904	20.1828	19.7226	19.1587	18.7161 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7364	18.9362	19.2747	19.7330	20.0915	20.2637	20.2930	20.2904	20.1828	19.7226	19.1587	18.7161 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9968	0.9932	0.9823	0.9433	0.8362	0.6379	0.4526	0.5149	0.8017	0.9652	0.9933	0.9976 (94)
Useful gains	594.5480	682.4132	767.3896	837.9290	809.6893	613.9322	414.6552	432.5791	604.4395	632.4936	581.9324	563.9124 (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												
	1697.9405	1645.5931	1492.9799	1247.2684	963.4489	641.7091	418.4223	439.6994	692.7280	1047.3868	1392.3970	1686.0975 (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												
	820.9240	647.2568	539.8392	294.7243	114.3971	0.0000	0.0000	0.0000	0.0000	308.6806	583.5345	834.9057 (98)
Space heating												4144.2623 (98)
Space heating per m2												(98) / (4) = 39.9293 (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 %)													93.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													4432.3661	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	820.9240	647.2568	539.8392	294.7243	114.3971	0.0000	0.0000	0.0000	0.0000	308.6806	583.5345	834.9057	(98)	
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)	
Space heating fuel (main heating system)	877.9936	692.2533	577.3681	315.2132	122.3498	0.0000	0.0000	0.0000	0.0000	330.1397	624.1011	892.9473	(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	214.1080	188.7177	198.2003	177.6806	174.1263	155.5957	149.4402	163.9724	163.6798	184.2442	194.8104	208.9591	(64)	
Efficiency of water heater (217)m	88.0575	87.8411	87.3545	86.1550	83.7249	79.8000	79.8000	79.8000	79.8000	86.1808	87.5614	88.1344	(216)	
Fuel for water heating, kWh/month	243.1456	214.8399	226.8920	206.2335	207.9744	194.9821	187.2684	205.4792	205.1125	213.7880	222.4842	237.0915	(219)	
Water heating fuel used												2565.2914	(219)	
Annual totals kWh/year														
Space heating fuel - main system												4432.3661	(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)													431.9021	(232)
Total delivered energy for all uses													7504.5596	(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	4432.3661	0.2160	957.3911 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2565.2914	0.2160	554.1029 (264)
Space and water heating			1511.4940 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	431.9021	0.5190	224.1572 (268)
Total CO2, kg/m2/year			1774.5762 (272)
Emissions per m2 for space and water heating			14.5630 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.1597 (272b)
Emissions per m2 for pumps and fans			0.3750 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5630 * 1.55) + 2.1597 + 0.3750, rounded to 2 d.p.			25.1100 (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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1562 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.3567 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3300 (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	0.4207	0.4125	0.4042	0.3630	0.3547	0.3135	0.3135	0.3052	0.3300	0.3547	0.3712	0.3877 (22b)
Effective ac	0.5885	0.5851	0.5817	0.5659	0.5629	0.5491	0.5491	0.5466	0.5544	0.5629	0.5689	0.5752 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	56.6003	(33)
E-WM-30					0.0000	0.0000	45.0000 (32)
Timber GF						9.0000	218.8800 (32c)
Timber 1F						9.0000	761.3100 (32c)
Timber 2F						9.0000	417.0600 (32c)
AAC GF						39.0000	1405.5600 (32c)
Internal Floor						12.6000	504.2520 (32d)
Internal Floor						12.6000	299.2500 (32d)
Internal Ceiling						9.0000	360.1800 (32e)
Internal Ceiling						9.0000	213.7500 (32e)
Heat capacity Cm = Sum (A x k)					(28)...(30) + (32) + (32a)...(32e) =		15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.7206 (36)
Total fabric heat loss					(33) + (36) =		64.3209 (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	49.7235	49.4332	49.1486	47.8117	47.5616	46.3973	46.3973	46.1817	46.8458	47.5616	48.0676	48.5966 (38)
Heat transfer coeff	114.0445	113.7541	113.4695	112.1327	111.8826	110.7182	110.7182	110.5026	111.1667	111.8826	112.3885	112.9175 (39)
Average = Sum(39)m / 12 =												112.1315 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0988	1.0960	1.0933	1.0804	1.0780	1.0668	1.0668	1.0647	1.0711	1.0780	1.0828	1.0879 (40)
HLP (average)												1.0804 (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												2.7719 (42)
Average daily hot water use (litres/day)												100.0338 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy content (annual)	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (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	34.6762	30.3280	31.2958	27.2844	26.1800	22.5914	20.9342	24.0224	24.3093	28.3301	30.9245	33.5820 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975 (66)
(66)m	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.4561	21.7217	17.6653	13.3737	9.9970	8.4399	9.1196	11.8540	15.9104	20.2020	23.5787	25.1358 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.3132	265.0352	258.1759	243.5732	225.1399	207.8152	196.2413	193.5193	200.3786	214.9813	233.4146	250.7393 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597 (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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780 (71)
Water heating gains (Table 5)	46.6078	45.1310	42.0642	37.8950	35.1882	31.3769	28.1374	32.2881	33.7629	38.0781	42.9507	45.1371 (72)
Total internal gains	397.9563	396.4671	382.4846	359.4212	334.9044	312.2113	298.0776	302.2407	314.6312	337.8406	364.5232	385.5914 (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					4.3400	11.2829	0.4600	0.0000	0.7700		17.3445 (75)	
Southwest					6.9300	36.7938	0.4600	0.0000	0.7700		90.3144 (79)	
Northeast					3.3300	11.2829	0.4300	0.0000	0.7700		12.4402 (75)	
Northeast					1.5000	16.8560	0.7100	0.7000	1.0000		11.3095 (82)	

Solar gains	131.4085	237.9216	363.2692	513.8860	634.1917	655.4825	621.1788	527.4015	414.7580	273.0970	159.9541	110.8080 (83)
Total gains	529.3648	634.3887	745.7538	873.3072	969.0962	967.6939	919.2563	829.6422	729.3892	610.9376	524.4774	496.3994 (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	36.6678	36.7614	36.8536	37.2929	37.3763	37.7693	37.7693	37.8430	37.6170	37.3763	37.2080	37.0337
alpha	3.4445	3.4508	3.4569	3.4862	3.4918	3.5180	3.5180	3.5229	3.5078	3.4918	3.4805	3.4689
util living area	0.9912	0.9830	0.9635	0.9110	0.8042	0.6455	0.5017	0.5653	0.7973	0.9470	0.9850	0.9929 (86)
MIT	19.1048	19.3397	19.7251	20.2252	20.6391	20.8837	20.9640	20.9455	20.7433	20.1918	19.5575	19.0656 (87)
Th 2	20.0018	20.0041	20.0063	20.0169	20.0189	20.0281	20.0281	20.0298	20.0245	20.0189	20.0149	20.0107 (88)
util rest of house	0.9894	0.9795	0.9556	0.8914	0.7614	0.5712	0.4019	0.4634	0.7369	0.9314	0.9813	0.9915 (89)
MIT 2	18.2616	18.4965	18.8785	19.3706	19.7524	19.9612	20.0141	20.0067	19.8569	19.3492	18.7225	18.2292 (90)
Living area fraction	18.5082	18.7431	19.1260	19.6205	20.0117	20.2310	20.2918	20.2812	20.1161	19.5956	18.9666	18.4738 (92)
MIT	18.5082	18.7431	19.1260	19.6205	20.0117	20.2310	20.2918	20.2812	20.1161	19.5956	18.9666	18.4738 (92)
Temperature adjustment	18.5082	18.7431	19.1260	19.6205	20.0117	20.2310	20.2918	20.2812	20.1161	19.5956	18.9666	18.4738 (93)
adjusted MIT	18.5082	18.7431	19.1260	19.6205	20.0117	20.2310	20.2918	20.2812	20.1161	19.5956	18.9666	18.4738 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9856	0.9736	0.9469	0.8821	0.7611	0.5877	0.4300	0.4912	0.7433	0.9231	0.9761	0.9883 (94)
Useful gains	521.7538	617.6555	706.1739	770.3508	737.5516	568.7104	395.2921	407.5355	542.1306	563.9330	511.9265	490.5923 (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	1620.3622	1574.7062	1432.6708	1202.1210	929.9379	623.4524	408.7536	428.8854	668.7851	1006.4489	1333.6742	1611.7582 (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	817.3647	643.1381	540.5137	310.8745	143.1354	0.0000	0.0000	0.0000	0.0000	329.2318	591.6584	834.1475 (98)
Space heating	817.3647	643.1381	540.5137	310.8745	143.1354	0.0000	0.0000	0.0000	0.0000	329.2318	591.6584	834.1475 (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) = 40.5633 (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	1040.7513	819.3148	839.8198	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8361	0.8915	0.8606	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	870.1670	730.3920	722.7133	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1220.3392	1162.6628	1063.6313	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	252.1240	321.6095	253.6430	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction												827.3764	(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	63.0310	80.4024	63.4107	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2												206.8441	(107)
Energy for space heating												1.9929	(108)
Energy for space cooling												40.5633	(99)
Total												1.9929	(108)
Dwelling Fabric Energy Efficiency (DFEE)												42.5562	(109)
												42.6	(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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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) = 0.1562 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4062 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3758 (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	0.4791	0.4697	0.4603	0.4133	0.4039	0.3570	0.3570	0.3476	0.3758	0.4039	0.4227	0.4415 (22b)
Effective ac	0.6148	0.6103	0.6059	0.5854	0.5816	0.5637	0.5637	0.5604	0.5706	0.5816	0.5894	0.5975 (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)			14.6000	1.3258	19.3561		(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876		(27a)
FP McCann System			40.0200	0.1300	5.2026		(28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.1800	15.9426		(29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.1800	0.6030		(29a)
Wall to Void	17.8000		17.8000	0.1800	3.2040		(29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.1300	1.6380		(30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1300	1.2493		(30)
Dormer Flat Roof	2.6400		2.6400	0.1300	0.3432		(30)
Ceiling to Void	16.2700		16.2700	0.1300	2.1151		(30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.1915		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4812 (36)
Total fabric heat loss						(33) + (36) =	65.6727 (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	51.9427	51.5662	51.1971	49.4635	49.1392	47.6293	47.6293	47.3497	48.2109	49.1392	49.7953	50.4813 (38)
Heat transfer coeff	117.6154	117.2389	116.8698	115.1362	114.8119	113.3020	113.3020	113.0224	113.8836	114.8119	115.4680	116.1540 (39)
Average = Sum(39)m / 12 =												115.1347 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1332	1.1296	1.1260	1.1093	1.1062	1.0916	1.0916	1.0890	1.0973	1.1062	1.1125	1.1191 (40)
HLP (average)												1.1093 (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												2.7719 (42)
Average daily hot water use (litres/day)												100.0338 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy conte	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1573.9214 (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	34.6762	30.3280	31.2958	27.2844	26.1800	22.5914	20.9342	24.0224	24.3093	28.3301	30.9245	33.5820 (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)
(66)m	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	138.5975	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.4561	21.7217	17.6653	13.3737	9.9970	8.4399	5.1196	11.8540	15.9104	20.2020	23.5787	25.1358	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.3132	265.0352	258.1759	243.5732	225.1399	207.8152	196.2413	193.5193	200.3786	214.9813	233.4146	250.7393	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	36.8597	(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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	(71)
Water heating gains (Table 5)	46.6078	45.1310	42.0642	37.8950	35.1882	31.3769	28.1374	32.2881	33.7629	38.0781	42.9507	45.1371	(72)
Total internal gains	397.9563	396.4671	382.4846	359.4212	334.9044	312.2113	298.0776	302.2407	314.6312	337.8406	364.5232	385.5914	(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				7.6700	11.2829	0.6300	0.7000	0.7700	26.4478 (75)			
Southwest				6.9300	36.7938	0.6300	0.7000	0.7700	77.9256 (79)			
Northeast				1.5000	16.8560	0.6300	0.7000	1.0000	10.0352 (82)			
Solar gains	114.4086	207.3839	317.2513	449.7098	555.7326	574.6864	544.4922	461.8223	362.5271	238.2080	139.3052	96.4448 (83)
Total gains	512.3649	603.8510	699.7360	809.1311	890.6370	886.8978	842.5698	764.0630	677.1583	576.0486	503.8285	482.0362 (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	61.2814	61.4782	61.6724	62.6010	62.7778	63.6144	63.6144	63.7718	63.2895	62.7778	62.4211	62.0524	
alpha	5.0854	5.0985	5.1115	5.1734	5.1852	5.2410	5.2410	5.2515	5.2193	5.1852	5.1614	5.1368	
util living area	0.9992	0.9980	0.9936	0.9739	0.9040	0.7451	0.5756	0.6488	0.8946	0.9881	0.9983	0.9994	(86)
MIT	19.6819	19.8330	20.0917	20.4483	20.7604	20.9412	20.9876	20.9779	20.8356	20.4300	19.9959	19.6627	(87)
Th 2	19.9738	19.9768	19.9796	19.9932	19.9958	20.0077	20.0077	20.0099	20.0031	19.9958	19.9906	19.9852	(88)
util rest of house	0.9989	0.9972	0.9912	0.9633	0.8651	0.6567	0.4540	0.5246	0.8362	0.9816	0.9975	0.9992	(89)
MIT 2	18.7651	18.9183	19.1782	19.5394	19.8298	19.9800	20.0044	20.0033	19.9062	19.5276	19.0924	18.7551	(90)
Living area fraction	19.0332	19.1858	19.4453	19.8052	20.1019	20.2610	20.2919	20.2883	20.1779	19.7915	19.3566	19.0205	(91)
MIT	19.0332	19.1858	19.4453	19.8052	20.1019	20.2610	20.2919	20.2883	20.1779	19.7915	19.3566	19.0205	(92)
Temperature adjustment	19.0332	19.1858	19.4453	19.8052	20.1019	20.2610	20.2919	20.2883	20.1779	19.7915	19.3566	19.0205	(93)
adjusted MIT	19.0332	19.1858	19.4453	19.8052	20.1019	20.2610	20.2919	20.2883	20.1779	19.7915	19.3566	19.0205	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9986	0.9965	0.9895	0.9608	0.8698	0.6810	0.4900	0.5613	0.8483	0.9798	0.9969	0.9990	(94)
Ext temp.	511.6296	601.7193	692.3658	777.3951	774.7085	603.9677	412.8691	428.9033	574.4145	564.4399	502.2553	481.5341	(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	1732.8529	1674.8462	1512.9202	1255.5818	964.6405	641.4069	418.3041	439.4619	692.1787	1055.2900	1415.2476	1721.4574	(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	908.5901	721.1413	610.4925	344.2944	141.3094	0.0000	0.0000	0.0000	0.0000	365.1925	657.3544	922.5030	(98)
Space heating per m2												4670.8775	(98)
												45.0032	(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	1065.0389	838.4349	858.9702	0.0000	0.0000	0.0000	0.0000	(100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8629	0.9241	0.8928	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	918.9808	774.7771	766.8537	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1127.9642	1074.9522	988.4916	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	150.4680	223.3303	164.8986	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												538.6969 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	37.6170	55.8326	41.2246	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												134.6742 (107)
Space cooling per m2												1.2976 (108)
Energy for space heating												45.0032 (99)
Energy for space cooling												1.2976 (108)
Total												46.3007 (109)
Target Fabric Energy Efficiency (TFEE)												53.2 (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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (5)

2. Ventilation rate

	main heating	+	secondary heating	+	other	=	total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							0 * 10 =	0.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						0.0000 / (5) =	0.0000 (8)				
Pressure test							Yes					
Measured/design AP50							4.0100					
Infiltration rate							0.2005 (18)					
Number of sides sheltered							1 (19)					
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.9250 (20)				
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.1855 (21)				
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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												
	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762 (22b)
Mechanical extract ventilation - decentralised												
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
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =				56.6003		(33)
E-WM-30			55.0100	0.0000	0.0000	45.0000	2475.4500 (32)
Timber GF			24.3200			9.0000	218.8800 (32c)
Timber 1F			84.5900			9.0000	761.3100 (32c)
Timber 2F			46.3400			9.0000	417.0600 (32c)
AAC GF			36.0400			39.0000	1405.5600 (32c)
Internal Floor			40.0200			12.6000	504.2520 (32d)
Internal Floor			23.7500			12.6000	299.2500 (32d)
Internal Ceiling			40.0200			9.0000	360.1800 (32e)
Internal Ceiling			23.7500			9.0000	213.7500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.7206 (36)
Total fabric heat loss (33) + (36) = 64.3209 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459 (38)
Heat transfer coeff	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669 (39)
Average = Sum(39)m / 12 =												106.5669 (39)
HLP	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268 (40)
HLP (average)												1.0268 (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												2.7719 (42)
Average daily hot water use (litres/day)												100.0338 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy content	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (45)
Energy content (annual)												Total = Sum(45)m = 1573.9214 (45)
Distribution loss (46)m = 0.15 x (45)m												236.0832 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	212.5588	187.3184	196.6511	176.1813	172.5770	154.0964	147.8909	162.4232	162.1805	182.6949	193.3111	207.4098 (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												
	212.5588	187.3184	196.6511	176.1813	172.5770	154.0964	147.8909	162.4232	162.1805	182.6949	193.3111	207.4098 (64)
Total per year (kWh/year) = Sum(64)m =												2155.2934 (64)
RHI water heating demand												2155 (64)
Heat gains from water heating, kWh/month												
	93.7594	83.1331	88.4701	80.9193	80.4655	73.5761	72.2574	77.0894	76.2640	83.8297	86.6150	92.0474 (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	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	61.1402	54.3042	44.1631	33.4343	24.9926	21.0998	22.7990	29.6351	39.7761	50.5049	58.9467	62.8395 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	391.5123	395.5750	385.3372	363.5421	336.0297	310.1720	292.8974	288.8348	299.0726	320.8676	348.3800	374.2377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036 (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)												
	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780 (71)
Water heating gains (Table 5)												
	126.0208	123.7100	118.9115	112.3879	108.1526	102.1890	97.1201	103.6147	105.9223	112.6743	120.2986	123.7197 (72)
Total internal gains	688.5159	683.4318	658.2544	619.2070	579.0175	543.3034	522.6593	531.9272	554.6136	593.8895	637.4679	670.6395 (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					4.3400	12.9236	0.4600	0.0000	0.7700	19.8665 (75)		
Southwest					6.9300	40.4699	0.4600	0.0000	0.7700	99.3377 (79)		
Northeast					3.3300	12.9236	0.4300	0.0000	0.7700	14.2490 (75)		
Northeast					1.5000	19.3863	0.7100	0.7000	1.0000	13.0072 (82)		
Solar gains	146.4604	239.4611	363.2384	532.3209	641.4763	709.8148	665.3148	576.8834	450.5924	294.0883	182.8122	122.2020 (83)
Total gains	834.9763	922.8929	1021.4928	1151.5279	1220.4938	1253.1182	1187.9740	1108.8106	1005.2060	887.9778	820.2801	792.8415 (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	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407
alpha	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160
util living area	0.9592	0.9413	0.8960	0.7938	0.6274	0.4139	0.2761	0.3045	0.5693	0.8279	0.9327	0.9648 (86)
Tweekday	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478
Tweekend	20.1905	20.3002	20.5162	20.7564	20.9214	20.9872	20.9979	20.9970	20.9584	20.7585	20.4380	20.1579
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.7507	19.9175	20.2533	20.6197	20.8786	20.9803	20.9967	20.9953	20.9351	20.6273	20.1225	19.7004 (87)
Th 2	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611 (88)
util rest of house	0.9516	0.9307	0.8772	0.7587	0.5705	0.3405	0.1934	0.2166	0.4915	0.7893	0.9184	0.9581 (89)
Tweekday	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478
Tweekend	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

MIT 2	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478 (90)
Living area fraction									fLA = Living area / (4) =			0.2924 (91)
MIT	18.8087	19.0283	19.4591	19.9206	20.2185	20.3210	20.3340	20.3332	20.2819	19.9351	19.3065	18.7433 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8087	19.0283	19.4591	19.9206	20.2185	20.3210	20.3340	20.3332	20.2819	19.9351	19.3065	18.7433 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9387	0.9162	0.8631	0.7529	0.5805	0.3612	0.2176	0.2423	0.5106	0.7835	0.9043	0.9460 (94)	
Useful gains	783.7829	845.6002	881.6879	866.9856	708.4461	452.5990	258.5542	268.7175	513.2434	695.7131	741.7800	749.9998 (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													
	1460.8979	1431.0171	1285.0988	1067.8599	769.2521	460.4765	259.3814	269.9537	541.5585	888.2407	1204.8938	1453.9231 (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													
	503.7736	393.4002	300.1377	144.6295	45.2397	0.0000	0.0000	0.0000	0.0000	143.2406	333.4419	523.7189 (98)	
Space heating													
RHI space heating demand												2387.5820 (98)	
												2388 (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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1855 (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	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179 (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
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =				56.6003		(33)
E-WM-30			55.0100	0.0000	0.0000	45.0000	2475.4500 (32)
Timber GF			24.3200			9.0000	218.8800 (32c)
Timber 1F			84.5900			9.0000	761.3100 (32c)
Timber 2F			46.3400			9.0000	417.0600 (32c)
AAC GF			36.0400			39.0000	1405.5600 (32c)
Internal Floor			40.0200			12.6000	504.2520 (32d)
Internal Floor			23.7500			12.6000	299.2500 (32d)
Internal Ceiling			40.0200			9.0000	360.1800 (32e)
Internal Ceiling			23.7500			9.0000	213.7500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.7206 (36)
Total fabric heat loss (33) + (36) = 64.3209 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459 (38)
Heat transfer coeff	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669 (39)
Average = Sum(39)m / 12 =												106.5669 (39)
HLP	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268 (40)
HLP (average)												1.0268 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7719 (42)
Average daily hot water use (litres/day)												100.0338 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy content	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (45)
Energy content (annual)												Total = Sum(45)m = 1573.9214 (45)
Distribution loss (46)m = 0.15 x (45)m	24.4773	21.4080	22.0911	19.2596	18.4800	15.9469	14.7771	16.9570	17.1595	19.9977	21.8291	23.7050 (46)
Water storage loss:												200.0000 (47)
Store volume												1.5600 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8424 (55)
Enter (49) or (54) in (55)												
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	212.5588	187.3184	196.6511	176.1813	172.5770	154.0964	147.8909	162.4232	162.1805	182.6949	193.3111	207.4098 (62)
WWHRS	-51.0124	-44.8851	-45.8106	-37.6867	-34.9903	-28.8634	-24.4248	-29.5739	-30.4381	-37.6310	-43.5953	-49.3069 eq. (G10)
Total of WWHRS savings	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-458.2184
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	161.5464	142.4333	150.8404	138.4946	137.5868	125.2330	123.4661	132.8493	131.7424	145.0639	149.7158	158.1030 (64)
Heat gains from water heating, kWh/month	93.7594	83.1331	88.4701	80.9193	80.4655	73.5761	72.2574	77.0894	76.2640	83.8297	86.6150	92.0474 (65)
												Total per year (kWh/year) = Sum(64)m = 1697.0749 (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	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.1402	54.3042	44.1631	33.4343	24.9926	21.0998	22.7990	29.6351	39.7761	50.5049	58.9467	62.8395 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	391.5123	395.5750	385.3372	363.5421	336.0297	310.1720	292.8974	288.8348	299.0726	320.8676	348.3800	374.2377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036 (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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780 (71)
Water heating gains (Table 5)	126.0208	123.7100	118.9115	112.3879	108.1526	102.1890	97.1201	103.6147	105.9223	112.6743	120.2986	123.7197 (72)
Total internal gains	688.5159	683.4318	658.2544	619.2070	579.0175	543.3034	522.6593	531.9272	554.6136	593.8895	637.4679	670.6395 (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					4.3400	11.2829	0.4600	0.0000	0.7700		17.3445 (75)	
Southwest					6.9300	36.7938	0.4600	0.0000	0.7700		90.3144 (79)	
Northeast					3.3300	11.2829	0.4300	0.0000	0.7700		12.4402 (75)	
Northeast					1.5000	16.8560	0.7100	0.7000	1.0000		11.3095 (82)	
Solar gains	131.4085	237.9216	363.2692	513.8860	634.1917	655.4825	621.1788	527.4015	414.7580	273.0970	159.9541	110.8080 (83)
Total gains	819.9244	921.3534	1021.5236	1133.0930	1213.2092	1198.7860	1143.8380	1059.3287	969.3716	866.9865	797.4221	781.4475 (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	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407
alpha	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160
util living area	0.9663	0.9482	0.9109	0.8309	0.6983	0.5345	0.4002	0.4470	0.6650	0.8679	0.9478	0.9713 (86)
Tweekday	18.2296	18.5207	18.9720	19.4849	19.8516	20.0144	20.0525	20.0473	19.9475	19.4833	18.7597	18.1411
Tweekend	20.1055	20.2371	20.4431	20.6848	20.8696	20.9626	20.9899	20.9849	20.9178	20.6776	20.3427	20.0656
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.6195	19.8198	20.1405	20.5078	20.7988	20.9425	20.9844	20.9766	20.8717	20.5024	19.9737	19.5579 (87)
Th 2	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611 (88)
util rest of house	0.9603	0.9391	0.8953	0.8019	0.6503	0.4665	0.3188	0.3620	0.5982	0.8382	0.9370	0.9660 (89)
Tweekday	18.2296	18.5207	18.9720	19.4849	19.8516	20.0144	20.0525	20.0473	19.9475	19.4833	18.7597	18.1411

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Tweekend	18.2296	18.5207	18.9720	19.4849	19.8516	20.0144	20.0525	20.0473	19.9475	19.4833	18.7597	18.1411
MIT 2	18.2296	18.5207	18.9720	19.4849	19.8516	20.0144	20.0525	20.0473	19.9475	19.4833	18.7597	18.1411 (90)
Living area fraction									fLA = Living area / (4) =			0.2924 (91)
MIT	18.6360	18.9006	19.3137	19.7840	20.1286	20.2858	20.3250	20.3191	20.2177	19.7813	19.1147	18.5554 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6360	18.9006	19.3137	19.7840	20.1286	20.2858	20.3250	20.3191	20.2177	19.7813	19.1147	18.5554 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9483	0.9250	0.8805	0.7924	0.6540	0.4833	0.3421	0.3859	0.6101	0.8280	0.9233	0.9549 (94)
Useful gains	777.5026	852.2182	899.4566	897.8846	793.4020	579.3627	391.2722	408.7831	591.3791	717.9004	736.2715	746.1748 (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	1527.7473	1491.9972	1365.5121	1159.8730	898.2073	605.9160	396.9597	417.6413	651.9464	978.4226	1280.3702	1529.8120 (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	558.1821	429.9315	346.7453	188.6316	77.9751	0.0000	0.0000	0.0000	0.0000	193.8285	391.7511	583.0261 (98)
Space heating per m2												2770.0713 (98)
												(98) / (4) = 26.6892 (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 %)												267.9464 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1033.8154 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	558.1821	429.9315	346.7453	188.6316	77.9751	0.0000	0.0000	0.0000	0.0000	193.8285	391.7511	583.0261 (98)
Space heating efficiency (main heating system 1)	267.9464	267.9464	267.9464	267.9464	267.9464	0.0000	0.0000	0.0000	0.0000	267.9464	267.9464	267.9464 (210)
Space heating fuel (main heating system)	208.3185	160.4543	129.4085	70.3990	29.1010	0.0000	0.0000	0.0000	0.0000	72.3385	146.2050	217.5905 (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	161.5464	142.4333	150.8404	138.4946	137.5868	125.2330	123.4661	132.8493	131.7424	145.0639	149.7158	158.1030 (64)
Efficiency of water heater (217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800 (216)
Fuel for water heating, kWh/month	94.8710	83.6465	88.5837	81.3334	80.8003	73.5453	72.5077	78.0181	77.3681	85.1914	87.9233	92.8488 (219)
Water heating fuel used												996.6378 (219)
Annual totals kWh/year												
Space heating fuel - main system												1033.8154 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)												
mechanical ventilation fans (SFP = 0.2294)												71.6664 (230a)
Total electricity for the above, kWh/year												71.6664 (231)
Electricity for lighting (calculated in Appendix L)												431.9021 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.20 * 1004 * 1.00) =										-963.8364		-963.8364 (233)
Total delivered energy for all uses												1570.1854 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1033.8154	13.1900	136.3602 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	996.6378	13.1900	131.4565 (247)
Mechanical ventilation fans	71.6664	13.1900	9.4528 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	431.9021	13.1900	56.9679 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-963.8364	13.1900	-127.1300 (252)
Total energy cost			207.1074 (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] =	0.5846 (257)
SAP value		91.8446

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SAP rating (Section 12)
SAP band

92 (258)
A

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	1033.8154	0.5190	536.5502 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	996.6378	0.5190	517.2550 (264)
Space and water heating			1053.8052 (265)
Pumps and fans	71.6664	0.5190	37.1949 (267)
Energy for lighting	431.9021	0.5190	224.1572 (268)
Energy saving/generation technologies			
PV Unit	-963.8364	0.5190	-500.2311 (269)
Total kg/year			814.9262 (272)
CO2 emissions per m2			7.8500 (273)
EI value			92.6608
EI rating			93 (274)
EI band			A

Calculation of stars for heating and DHW

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.00) / 2.6795 = 4.923$, stars = 4
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.00) / 2.6795 = 0.1937$, stars = 5
Water heating energy efficiency	$13.19 / 1.7028 = 7.746$, stars = 3
Water heating environmental impact	$0.519 / 1.7028 = 0.3048$, stars = 5

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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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1855 (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	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762 (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
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =				56.6003		(33)
E-WM-30			55.0100	0.0000	0.0000	45.0000	2475.4500 (32)
Timber GF			24.3200			9.0000	218.8800 (32c)
Timber 1F			84.5900			9.0000	761.3100 (32c)
Timber 2F			46.3400			9.0000	417.0600 (32c)
AAC GF			36.0400			39.0000	1405.5600 (32c)
Internal Floor			40.0200			12.6000	504.2520 (32d)
Internal Floor			23.7500			12.6000	299.2500 (32d)
Internal Ceiling			40.0200			9.0000	360.1800 (32e)
Internal Ceiling			23.7500			9.0000	213.7500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.7206 (36)
Total fabric heat loss (33) + (36) = 64.3209 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459 (38)
Heat transfer coeff	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669 (39)
Average = Sum(39)m / 12 =												106.5669 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268 (40)
HLP (average)												1.0268 (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												2.7719 (42)
Average daily hot water use (litres/day)												100.0338 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372 (44)
Energy content	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330 (45)
Energy content (annual)												Total = Sum(45)m = 1573.9214 (45)
Distribution loss (46)m = 0.15 x (45)m	24.4773	21.4080	22.0911	19.2596	18.4800	15.9469	14.7771	16.9570	17.1595	19.9977	21.8291	23.7050 (46)
Water storage loss:												200.0000 (47)
Store volume												1.5600 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8424 (55)
Enter (49) or (54) in (55)												
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	212.5588	187.3184	196.6511	176.1813	172.5770	154.0964	147.8909	162.4232	162.1805	182.6949	193.3111	207.4098 (62)
WWHRS	-51.0124	-44.8851	-45.8106	-37.6867	-34.9903	-28.8634	-24.4248	-29.5739	-30.4381	-37.6310	-43.5953	-49.3069 eq. (G10)
Total of WWHRS savings	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-458.2184
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	161.5464	142.4333	150.8404	138.4946	137.5868	125.2330	123.4661	132.8493	131.7424	145.0639	149.7158	158.1030 (64)
Heat gains from water heating, kWh/month	93.7594	83.1331	88.4701	80.9193	80.4655	73.5761	72.2574	77.0894	76.2640	83.8297	86.6150	92.0474 (65)
												Total per year (kWh/year) = Sum(64)m = 1697.0749 (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	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.1402	54.3042	44.1631	33.4343	24.9926	21.0998	22.7990	29.6351	39.7761	50.5049	58.9467	62.8395 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	391.5123	395.5750	385.3372	363.5421	336.0297	310.1720	292.8974	288.8348	299.0726	320.8676	348.3800	374.2377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036 (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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780 (71)
Water heating gains (Table 5)	126.0208	123.7100	118.9115	112.3879	108.1526	102.1890	97.1201	103.6147	105.9223	112.6743	120.2986	123.7197 (72)
Total internal gains	688.5159	683.4318	658.2544	619.2070	579.0175	543.3034	522.6593	531.9272	554.6136	593.8895	637.4679	670.6395 (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					4.3400	12.9236	0.4600	0.0000	0.7700		19.8665 (75)	
Southwest					6.9300	40.4699	0.4600	0.0000	0.7700		99.3377 (79)	
Northeast					3.3300	12.9236	0.4300	0.0000	0.7700		14.2490 (75)	
Northeast					1.5000	19.3863	0.7100	0.7000	1.0000		13.0072 (82)	
Solar gains	146.4604	239.4611	363.2384	532.3209	641.4763	709.8148	665.3148	576.8834	450.5924	294.0883	182.8122	122.2020 (83)
Total gains	834.9763	922.8929	1021.4928	1151.5279	1220.4938	1253.1182	1187.9740	1108.8106	1005.2060	887.9778	820.2801	792.8415 (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	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407
alpha	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160
util living area	0.9592	0.9413	0.8960	0.7938	0.6274	0.4139	0.2761	0.3045	0.5693	0.8279	0.9327	0.9648 (86)
Tweekday	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478
Tweekend	20.1905	20.3002	20.5162	20.7564	20.9214	20.9872	20.9979	20.9584	20.7585	20.4380	20.1579	20.1579
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.7507	19.9175	20.2533	20.6197	20.8786	20.9803	20.9967	20.9953	20.9351	20.6273	20.1225	19.7004 (87)
Th 2	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611 (88)
util rest of house	0.9516	0.9307	0.8772	0.7587	0.5705	0.3405	0.1934	0.2166	0.4915	0.7893	0.9184	0.9581 (89)
Tweekday	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478

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Tweekend	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478
MIT 2	18.4195	18.6609	19.1309	19.6316	19.9457	20.0486	20.0601	20.0595	20.0119	19.6490	18.9692	18.3478 (90)
Living area fraction									fLA = Living area / (4) =			0.2924 (91)
MIT	18.8087	19.0283	19.4591	19.9206	20.2185	20.3210	20.3340	20.3332	20.2819	19.9351	19.3065	18.7433 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8087	19.0283	19.4591	19.9206	20.2185	20.3210	20.3340	20.3332	20.2819	19.9351	19.3065	18.7433 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9387	0.9162	0.8631	0.7529	0.5805	0.3612	0.2176	0.2423	0.5106	0.7835	0.9043	0.9460	(94)
Useful gains	783.7829	845.6002	881.6879	866.9856	708.4461	452.5990	258.5542	268.7175	513.2434	695.7131	741.7800	749.9998	(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	1460.8979	1431.0171	1285.0988	1067.8599	769.2521	460.4765	259.3814	269.9537	541.5585	888.2407	1204.8938	1453.9231	(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	503.7736	393.4002	300.1377	144.6295	45.2397	0.0000	0.0000	0.0000	0.0000	143.2406	333.4419	523.7189	(98)
Space heating per m2												2387.5820	(98)
										(98) / (4) =		23.0040	(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 %)													267.9464 (206)
Efficiency of secondary/supplementary heating system, %													100.0000 (208)
Space heating requirement													891.0669 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	503.7736	393.4002	300.1377	144.6295	45.2397	0.0000	0.0000	0.0000	0.0000	143.2406	333.4419	523.7189	(98)
Space heating efficiency (main heating system 1)	267.9464	267.9464	267.9464	267.9464	267.9464	0.0000	0.0000	0.0000	0.0000	267.9464	267.9464	267.9464	(210)
Space heating fuel (main heating system)	188.0128	146.8205	112.0141	53.9770	16.8838	0.0000	0.0000	0.0000	0.0000	53.4587	124.4435	195.4566	(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	161.5464	142.4333	150.8404	138.4946	137.5868	125.2330	123.4661	132.8493	131.7424	145.0639	149.7158	158.1030	(64)
Efficiency of water heater (217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(216)
Fuel for water heating, kWh/month	94.8710	83.6465	88.5837	81.3334	80.8003	73.5453	72.5077	78.0181	77.3681	85.1914	87.9233	92.8488	(219)
Water heating fuel used												996.6378	(219)
Annual totals kWh/year													
Space heating fuel - main system												891.0669	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)													
mechanical ventilation fans (SFP = 0.2294)													71.6664 (230a)
Total electricity for the above, kWh/year													71.6664 (231)
Electricity for lighting (calculated in Appendix L)													431.9021 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1059 * 1.00) =										-1016.6283		-1016.6283	(233)
Total delivered energy for all uses												1374.6449	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	891.0669	16.9600	151.1250	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	996.6378	16.9600	169.0298	(247)
Mechanical ventilation fans	71.6664	16.9600	12.1546	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	431.9021	16.9600	73.2506	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1016.6283	16.9600	-172.4202	(252)
Total energy cost			233.1398	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	891.0669	0.5190	462.4637	(261)

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Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	996.6378	0.5190	517.2550 (264)
Space and water heating			979.7188 (265)
Pumps and fans	71.6664	0.5190	37.1949 (267)
Energy for lighting	431.9021	0.5190	224.1572 (268)
Energy saving/generation technologies			
PV Unit	-1016.6283	0.5190	-527.6301 (269)
Total kg/year			713.4407 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	891.0669	3.0700	2735.5755 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	996.6378	3.0700	3059.6782 (264)
Space and water heating			5795.2536 (265)
Pumps and fans	71.6664	3.0700	220.0158 (267)
Energy for lighting	431.9021	3.0700	1325.9395 (268)
Energy saving/generation technologies			
PV Unit	-1016.6283	3.0700	-3121.0490 (269)
Primary energy kWh/year			4220.1600 (272)
Primary energy kWh/m2/year			40.6606 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	A 92
Current environmental impact rating:	A 93

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.0	-£ 68	-207 kg (29.0%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar water heating	£68	1.99 kg/m²	A 94
Total Savings	£68	1.99 kg/m²	A 94

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

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	£406	£338	£68
Space heating	£163	£164	-£0
Water heating	£169	£101	£68

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Lighting	£73	£73	£0
Generated (PV)	-£172	-£172	£0
Total cost of fuels	£234	£166	£68
Total cost of uses	£233	£166	£68
Delivered energy	13 kWh/m²	9 kWh/m²	4 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	41 kWh/m²	29 kWh/m²	12 kWh/m²

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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1855 (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	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179 (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
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =				56.6003		(33)
E-WM-30			55.0100	0.0000	0.0000	45.0000	2475.4500 (32)
Timber GF			24.3200			9.0000	218.8800 (32c)
Timber 1F			84.5900			9.0000	761.3100 (32c)
Timber 2F			46.3400			9.0000	417.0600 (32c)
AAC GF			36.0400			39.0000	1405.5600 (32c)
Internal Floor			40.0200			12.6000	504.2520 (32d)
Internal Floor			23.7500			12.6000	299.2500 (32d)
Internal Ceiling			40.0200			9.0000	360.1800 (32e)
Internal Ceiling			23.7500			9.0000	213.7500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.7206 (36)
Total fabric heat loss (33) + (36) = 64.3209 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459 (38)
Heat transfer coeff	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669 (39)
Average = Sum(39)m / 12 =												106.5669 (39)
HLP	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268 (40)
HLP (average)												1.0268 (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

2.7719 (42)

Average daily hot water use (litres/day)

100.0338 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372	(44)
Energy content	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330	(45)
Energy content (annual)	Total = Sum(45)m =											1573.9214	(45)
Distribution loss (46)m = 0.15 x (45)m	24.4773	21.4080	22.0911	19.2596	18.4800	15.9469	14.7771	16.9570	17.1595	19.9977	21.8291	23.7050	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.5600 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8424 (55)
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	212.5588	187.3184	195.2553	169.4277	159.7827	141.4897	134.8640	150.3267	156.7776	181.2991	193.3111	207.4098	(62)
WWHRS	-51.0124	-44.8851	-45.8106	-37.6867	-34.9903	-28.8634	-24.4248	-29.5739	-30.4381	-37.6310	-43.5953	-49.3069	eq. (G10)
Total of WWHRS savings													-458.2184
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.7000 (H2)
Collector heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0050 (H3a)
Collector effective heat loss coefficient													1.8063 (H3b)
Collector performance ratio													2.5804 (H4)
Annual solar radiation per m2													1079.5246 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													1813.6014 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.6255 (H8)
Utilisation factor													0.4595 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													100.0338 (H14)
Volume ratio Veff/V													0.7497 (H15)
Solar storage volume factor													0.9424 (H16)
Solar input													-690.4889 (H17)
Solar input	-20.0228	-33.4123	-56.9050	-76.2639	-94.2176	-92.6309	-91.4067	-79.8625	-62.5484	-42.7132	-23.7499	-16.7557	(63)
Solar input (sum of months) = Sum(63)m =													-690.4889 (63)
Output from w/h	141.5236	109.0210	92.5397	55.4771	30.5748	19.9954	19.0324	40.8903	63.7911	100.9549	125.9659	141.3473	(64)
Total per year (kWh/year) = Sum(64)m =													941.1136 (64)
Heat gains from water heating, kWh/month	93.7594	83.1331	87.3535	75.5164	70.2301	63.4907	61.8358	67.4122	71.9417	82.7131	86.6150	92.0474	(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	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.1402	54.3042	44.1631	33.4343	24.9926	21.0998	22.7990	29.6351	39.7761	50.5049	58.9467	62.8395	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	391.5123	395.5750	385.3372	363.5421	336.0297	310.1720	292.8974	288.8348	299.0726	320.8676	348.3800	374.2377	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	(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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	(71)
Water heating gains (Table 5)	126.0208	123.7100	117.4107	104.8839	94.3952	88.1815	83.1127	90.6078	99.9191	111.1735	120.2986	123.7197	(72)
Total internal gains	688.5159	683.4318	656.7536	611.7030	565.2602	529.2959	508.6518	518.9203	548.6104	592.3887	637.4679	670.6395	(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					4.3400	11.2829	0.4600	0.0000	0.7700	17.3445 (75)		
Southwest					6.9300	36.7938	0.4600	0.0000	0.7700	90.3144 (79)		
Northeast					3.3300	11.2829	0.4300	0.0000	0.7700	12.4402 (75)		
Northeast					1.5000	16.8560	0.7100	0.7000	1.0000	11.3095 (82)		

Solar gains	131.4085	237.9216	363.2692	513.8860	634.1917	655.4825	621.1788	527.4015	414.7580	273.0970	159.9541	110.8080 (83)
Total gains	819.9244	921.3534	1020.0228	1125.5890	1199.4519	1184.7785	1129.8306	1046.3218	963.3684	865.4857	797.4221	781.4475 (84)

7. Mean internal temperature (heating season)

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Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407
alpha	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160
util living area	0.9663	0.9482	0.9113	0.8332	0.7033	0.5397	0.4047	0.4520	0.6678	0.8684	0.9478	0.9713 (86)
Weekday	18.2296	18.5207	18.9700	19.4783	19.8460	20.0128	20.0521	20.0468	19.9457	19.4817	18.7597	18.1411
Weekend	20.1055	20.2371	20.4422	20.6814	20.8664	20.9614	20.9895	20.9843	20.9167	20.6768	20.3427	20.0656
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.6195	19.8198	20.1391	20.5026	20.7938	20.9407	20.9838	20.9758	20.8699	20.5012	19.9737	19.5579 (87)
Th 2	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611 (88)
util rest of house	0.9603	0.9391	0.8956	0.8044	0.6555	0.4713	0.3226	0.3662	0.6010	0.8388	0.9370	0.9660 (89)
Weekday	18.2296	18.5207	18.9700	19.4783	19.8460	20.0128	20.0521	20.0468	19.9457	19.4817	18.7597	18.1411
Weekend	18.2296	18.5207	18.9700	19.4783	19.8460	20.0128	20.0521	20.0468	19.9457	19.4817	18.7597	18.1411
MIT 2	18.2296	18.5207	18.9700	19.4783	19.8460	20.0128	20.0521	20.0468	19.9457	19.4817	18.7597	18.1411 (90)
Living area fraction									fLA = Living area / (4) =			0.2924 (91)
MIT	18.6360	18.9006	19.3118	19.7778	20.1232	20.2841	20.3246	20.3184	20.2159	19.7798	19.1147	18.5554 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6360	18.9006	19.3118	19.7778	20.1232	20.2841	20.3246	20.3184	20.2159	19.7798	19.1147	18.5554 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9483	0.9250	0.8809	0.7947	0.6589	0.4881	0.3461	0.3903	0.6128	0.8286	0.9233	0.9549 (94)
Useful gains	777.5026	852.2182	898.5042	894.5527	790.2777	578.3300	391.0082	408.3851	590.3266	717.1285	736.2715	746.1748 (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	1527.7473	1491.9972	1365.3165	1159.2110	897.6321	605.7397	396.9156	417.5746	651.7572	978.2676	1280.3702	1529.8120 (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	558.1821	429.9315	347.3083	190.5540	79.8717	0.0000	0.0000	0.0000	0.0000	194.2875	391.7511	583.0261 (98)
Space heating												2774.9122 (98)
Space heating per m2												(98) / (4) = 26.7358 (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 %)												267.9464 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1035.6220 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	558.1821	429.9315	347.3083	190.5540	79.8717	0.0000	0.0000	0.0000	0.0000	194.2875	391.7511	583.0261 (98)
Space heating efficiency (main heating system 1)	267.9464	267.9464	267.9464	267.9464	267.9464	0.0000	0.0000	0.0000	0.0000	267.9464	267.9464	267.9464 (210)
Space heating fuel (main heating system)	208.3185	160.4543	129.6186	71.1164	29.8088	0.0000	0.0000	0.0000	0.0000	72.5098	146.2050	217.5905 (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	141.5236	109.0210	92.5397	55.4771	30.5748	19.9954	19.0324	40.8903	63.7911	100.9549	125.9659	141.3473 (64)
Efficiency of water heater												170.2800 (216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800 (217)
Fuel for water heating, kWh/month	83.1123	64.0246	54.3456	32.5799	17.9556	11.7426	11.1771	24.0136	37.4625	59.2876	73.9757	83.0088 (219)
Water heating fuel used												552.6860 (219)
Annual totals kWh/year												
Space heating fuel - main system												1035.6220 (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)												71.6664 (230a)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												121.6664 (231)
Electricity for lighting (calculated in Appendix L)												431.9021 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.20 * 1004 * 1.00) =												-963.8364 (233)
Total delivered energy for all uses												1178.0401 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1035.6220	13.1900	136.5985 (240)

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Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	552.6860	13.1900	72.8993 (247)
Mechanical ventilation fans	71.6664	13.1900	9.4528 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	431.9021	13.1900	56.9679 (250)
Additional standing charges			0.0000 (251)

Energy saving/generation technologies			
PV Unit	-963.8364	13.1900	-127.1300 (252)
Total energy cost			155.3835 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4386 (257)
SAP value		93.8814
SAP rating (Section 12)		94 (258)
SAP band		A

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	1035.6220	0.5190	537.4878	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	552.6860	0.5190	286.8440	(264)
Space and water heating			824.3318	(265)
Pumps and fans	121.6664	0.5190	63.1449	(267)
Energy for lighting	431.9021	0.5190	224.1572	(268)
Energy saving/generation technologies				
PV Unit	-963.8364	0.5190	-500.2311	(269)
Total kg/year			611.4028	(272)
CO2 emissions per m2			5.8900	(273)
EI value			94.4937	
EI rating			94	(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	40.0200 (1b)	x 2.3100 (2b)	= 92.4462 (1b) - (3b)
First floor	40.0200 (1c)	x 2.6100 (2c)	= 104.4522 (1c) - (3c)
Second floor	23.7500 (1d)	x 2.4900 (2d)	= 59.1375 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	103.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 256.0359 (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					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1855 (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	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762 (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
Solid Door			2.1500	1.0000	2.1500		(26)
Window (Uw = 1.20)			11.2700	1.1450	12.9046		(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148		(27)
Roof Window (Uw = 1.80)			1.5000	1.6791	2.5187		(27a)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000 (28a)
100mm Knauf Supafil 34	103.5700	15.0000	88.5700	0.2500	22.1425	52.8000	4676.4960 (29a)
Dormer Cheek	5.1000	1.7500	3.3500	0.2800	0.9380	9.0000	30.1500 (29a)
Wall to Void	17.8000		17.8000	0.1200	2.1360	18.0000	320.4000 (29a)
Plane Ceiling-500mm Loft Roll	12.6000		12.6000	0.0900	1.1340	9.0000	113.4000 (30)
Sloping Ceiling	11.1100	1.5000	9.6100	0.1600	1.5376	9.0000	86.4900 (30)
Dormer Flat Roof	2.6400		2.6400	0.1400	0.3696	9.0000	23.7600 (30)
Ceiling to Void	16.2700		16.2700	0.1200	1.9524	9.0000	146.4300 (30)
Total net area of external elements Aum(A, m ²)			209.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.6003		(33)
E-WM-30			55.0100	0.0000	0.0000	45.0000	2475.4500 (32)
Timber GF			24.3200			9.0000	218.8800 (32c)
Timber 1F			84.5900			9.0000	761.3100 (32c)
Timber 2F			46.3400			9.0000	417.0600 (32c)
AAC GF			36.0400			39.0000	1405.5600 (32c)
Internal Floor			40.0200			12.6000	504.2520 (32d)
Internal Floor			23.7500			12.6000	299.2500 (32d)
Internal Ceiling			40.0200			9.0000	360.1800 (32e)
Internal Ceiling			23.7500			9.0000	213.7500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15054.3180 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 145.0459 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.7206 (36)
Total fabric heat loss (33) + (36) = 64.3209 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459	42.2459 (38)
Average = Sum(39)m / 12 =	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669	106.5669 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268	1.0268 (40)
HLP (average)												1.0268 (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

2.7719 (42)

Average daily hot water use (litres/day)

100.0338 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.0372	106.0358	102.0345	98.0331	94.0318	90.0304	90.0304	94.0318	98.0331	102.0345	106.0358	110.0372	(44)
Energy content	163.1820	142.7200	147.2743	128.3973	123.2002	106.3124	98.5141	113.0464	114.3965	133.3181	145.5271	158.0330	(45)
Energy content (annual)	Total = Sum(45)m =											1573.9214	(45)
Distribution loss (46)m = 0.15 x (45)m	24.4773	21.4080	22.0911	19.2596	18.4800	15.9469	14.7771	16.9570	17.1595	19.9977	21.8291	23.7050	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.5600 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8424 (55)
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	212.5588	187.3184	195.2553	169.4277	159.7827	141.4897	134.8640	150.3267	156.7776	181.2991	193.3111	207.4098	(62)
WWHRS	-51.0124	-44.8851	-45.8106	-37.6867	-34.9903	-28.8634	-24.4248	-29.5739	-30.4381	-37.6310	-43.5953	-49.3069	eq. (G10)
Total of WWHRS savings													-458.2184
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.7000 (H2)
Collector heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0050 (H3a)
Collector effective heat loss coefficient													1.8063 (H3b)
Collector performance ratio													2.5804 (H4)
Annual solar radiation per m2													1140.0998 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													1915.3676 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.7167 (H8)
Utilisation factor													0.4415 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													100.0338 (H14)
Volume ratio Veff/V													0.7497 (H15)
Solar storage volume factor													0.9424 (H16)
Solar input													-700.7290 (H17)
Solar input	-21.5681	-32.4168	-54.5940	-75.4656	-90.8860	-95.6535	-93.3567	-83.3681	-65.0691	-44.2653	-26.2166	-17.8693	(63)
Solar input (sum of months) = Sum(63)m =													-700.7290 (63)
Output from w/h	139.9783	110.0165	94.8507	56.2754	33.9065	16.9728	17.0825	37.3848	61.2704	99.4028	123.4992	140.2337	(64)
Total per year (kWh/year) = Sum(64)m =													930.8735 (64)
Heat gains from water heating, kWh/month	93.7594	83.1331	87.3535	75.5164	70.2301	63.4907	61.8358	67.4122	71.9417	82.7131	86.6150	92.0474	(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	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	166.3170	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.1402	54.3042	44.1631	33.4343	24.9926	21.0998	22.7990	29.6351	39.7761	50.5049	58.9467	62.8395	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	391.5123	395.5750	385.3372	363.5421	336.0297	310.1720	292.8974	288.8348	299.0726	320.8676	348.3800	374.2377	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	54.4036	(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)	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	-110.8780	(71)
Water heating gains (Table 5)	126.0208	123.7100	117.4107	104.8839	94.3952	88.1815	83.1127	90.6078	99.9191	111.1735	120.2986	123.7197	(72)
Total internal gains	688.5159	683.4318	656.7536	611.7030	565.2602	529.2959	508.6518	518.9203	548.6104	592.3887	637.4679	670.6395	(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					4.3400	12.9236	0.4600	0.0000	0.7700		19.8665 (75)		
Southwest					6.9300	40.4699	0.4600	0.0000	0.7700		99.3377 (79)		
Northeast					3.3300	12.9236	0.4300	0.0000	0.7700		14.2490 (75)		
Northeast					1.5000	19.3863	0.7100	0.7000	1.0000		13.0072 (82)		
Solar gains	146.4604	239.4611	363.2384	532.3209	641.4763	709.8148	665.3148	576.8834	450.5924	294.0883	182.8122	122.2020	(83)
Total gains	834.9763	922.8929	1019.9920	1144.0239	1206.7365	1239.1107	1173.9666	1095.8036	999.2028	886.4770	820.2801	792.8415	(84)

7. Mean internal temperature (heating season)

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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	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407	39.2407
alpha	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160	3.6160
util living area	0.9592	0.9413	0.8964	0.7963	0.6326	0.4182	0.2793	0.3080	0.5720	0.8285	0.9327	0.9648 (86)
Weekday	18.4195	18.6609	19.1290	19.6263	19.9423	20.0481	20.0600	20.0595	20.0111	19.6477	18.9692	18.3478
Weekend	20.1905	20.3002	20.5153	20.7536	20.9192	20.9867	20.9978	20.9969	20.9578	20.7578	20.4380	20.1579
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.7507	19.9175	20.2519	20.6153	20.8753	20.9796	20.9966	20.9952	20.9341	20.6263	20.1225	19.7004 (87)
Th 2	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611	20.0611 (88)
util rest of house	0.9516	0.9307	0.8776	0.7613	0.5756	0.3442	0.1957	0.2192	0.4941	0.7900	0.9184	0.9581 (89)
Weekday	18.4195	18.6609	19.1290	19.6263	19.9423	20.0481	20.0600	20.0595	20.0111	19.6477	18.9692	18.3478
Weekend	18.4195	18.6609	19.1290	19.6263	19.9423	20.0481	20.0600	20.0595	20.0111	19.6477	18.9692	18.3478
MIT 2	18.4195	18.6609	19.1290	19.6263	19.9423	20.0481	20.0600	20.0595	20.0111	19.6477	18.9692	18.3478 (90)
Living area fraction									fLA = Living area / (4) =			0.2924 (91)
MIT	18.8087	19.0283	19.4574	19.9155	20.2151	20.3205	20.3339	20.3331	20.2810	19.9339	19.3065	18.7433 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8087	19.0283	19.4574	19.9155	20.2151	20.3205	20.3339	20.3331	20.2810	19.9339	19.3065	18.7433 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9387	0.9162	0.8635	0.7554	0.5854	0.3650	0.2202	0.2452	0.5131	0.7841	0.9043	0.9460 (94)
Useful gains	783.7829	845.6002	880.7982	864.1944	706.4236	452.2711	258.5137	268.6584	512.7022	695.0751	741.7800	749.9998 (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	1460.8979	1431.0171	1284.9171	1067.3168	768.8929	460.4219	259.3743	269.9434	541.4650	888.1154	1204.8938	1453.9231 (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	503.7736	393.4002	300.6644	146.2481	46.4772	0.0000	0.0000	0.0000	0.0000	143.6220	333.4419	523.7189 (98)
Space heating												2391.3463 (98)
Space heating per m2										(98) / (4) =		23.0402 (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 %)												267.9464 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												892.4718 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	503.7736	393.4002	300.6644	146.2481	46.4772	0.0000	0.0000	0.0000	0.0000	143.6220	333.4419	523.7189 (98)
Space heating efficiency (main heating system 1)	267.9464	267.9464	267.9464	267.9464	267.9464	0.0000	0.0000	0.0000	0.0000	267.9464	267.9464	267.9464 (210)
Space heating fuel (main heating system)	188.0128	146.8205	112.2107	54.5811	17.3457	0.0000	0.0000	0.0000	0.0000	53.6010	124.4435	195.4566 (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	139.9783	110.0165	94.8507	56.2754	33.9065	16.9728	17.0825	37.3848	61.2704	99.4028	123.4992	140.2337 (64)
Efficiency of water heater	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800 (216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800 (217)
Fuel for water heating, kWh/month	82.2048	64.6092	55.7028	33.0487	19.9122	9.9676	10.0320	21.9549	35.9822	58.3761	72.5271	82.3548 (219)
Water heating fuel used												546.6722 (219)
Annual totals kWh/year												892.4718 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
Electricity for pumps and fans:												
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)												
mechanical ventilation fans (SFP = 0.2294)												71.6664 (230a)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												121.6664 (231)
Electricity for lighting (calculated in Appendix L)												431.9021 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.20 * 1059 * 1.00) =												-1016.6283 (233)
Total delivered energy for all uses												976.0842 (238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	892.4718	16.9600	151.3632 (240)

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Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	546.6722	16.9600	92.7156 (247)
Mechanical ventilation fans	71.6664	16.9600	12.1546 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	50.0000	16.9600	8.4800 (249)
Energy for lighting	431.9021	16.9600	73.2506 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-1016.6283	16.9600	-172.4202 (252)
Total energy cost			165.5439 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	892.4718	0.5190	463.1929 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	546.6722	0.5190	283.7229 (264)
Space and water heating			746.9158 (265)
Pumps and fans	121.6664	0.5190	63.1449 (267)
Energy for lighting	431.9021	0.5190	224.1572 (268)
Energy saving/generation technologies			
PV Unit	-1016.6283	0.5190	-527.6301 (269)
Total kg/year			506.5877 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	892.4718	3.0700	2739.8885 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	546.6722	3.0700	1678.2838 (264)
Space and water heating			4418.1722 (265)
Pumps and fans	121.6664	3.0700	373.5158 (267)
Energy for lighting	431.9021	3.0700	1325.9395 (268)
Energy saving/generation technologies			
PV Unit	-1016.6283	3.0700	-3121.0490 (269)
Primary energy kWh/year			2996.5786 (272)
Primary energy kWh/m2/year			28.8716 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	145.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	337.97 (P1)
Transmission heat loss coefficient	64.32 (37)
Summer heat loss coefficient	402.29 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North East	0.000	1.000	None
South West	0.000	1.000	None
Solar shading	Z_blinds	Solar access	Z_overhangs
Orientation			
North East	1.000	0.90	1.000
North East	1.000	1.00	1.000
South West	1.000	0.90	1.000

[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	4.3400	98.8453	0.4600	0.0000	0.9000	177.6012
South West	6.9300	119.9223	0.4600	0.0000	0.9000	344.0596
North East	3.3300	98.8453	0.4300	0.0000	0.9000	127.3829
North East	1.5000	163.9792	0.7100	0.7000	1.0000	110.0218

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

total:				759.0655
	Jun	Jul	Aug	
Solar gains	810	759	659	(P3/P4)
Internal gains	543	523	532	
Total summer gains	1353	1282	1191	(P5)
Summer gain/loss ratio	3.36	3.19	2.96	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 145.0)	0.98	0.98	0.98	
Threshold temperature	20.35	22.07	21.75	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature:	Medium			
