

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-145				Issued on Date	13/06/2019
Assessment Reference	As Built	Prop Type Ref	P506 - Det (As)			
Property	47, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	89 B	DER	11.25	TER	13.92	
Environmental	89 B	% DER<TER	19.16			
CO ₂ Emissions (t/year)	1.62	DFEE	43.91	TFEE	50.38	
General Requirements Compliance	Pass	% DFEE<TFEE	12.85			
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk				Assessor ID	T511-0001
Client						

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

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DWELLING AS BUILT

Detached House, total floor area 183 m²

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

1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 13.92 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 11.25 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.4 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)43.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.37 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals:	4.63 (measured in this dwelling)	
Maximum	10.0	OK

4 Heating efficiency

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

Data from database

Potterton Ultra 18 Heat 18

Efficiency: 89.2% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.61 kWh/day

Permitted by DBSCG 2.56 OK

Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK

Independent timer for DHW OK

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%

Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Southern England): Slight OK

Based on:

Overshading:	Average
Windows facing North:	1.70 m ² , No overhang
Windows facing North East:	1.83 m ² , No overhang
Windows facing South East:	19.15 m ² , No overhang
Windows facing South West:	1.13 m ² , No overhang
Windows facing West:	1.70 m ² , No overhang
Windows facing North West:	8.45 m ² , No overhang
Air change rate:	4.00 ach
Blinds/curtains:	None

10 Key features

Door U-value 0.90 W/m²K

Thermal bridging y-value 0.035 W/m²K

Photovoltaic array 1.08 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1139 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3454 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2936 (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	0.3743	0.3670	0.3597	0.3230	0.3156	0.2789	0.2789	0.2716	0.2936	0.3156	0.3303	0.3450 (22b)
Effective ac	0.5701	0.5673	0.5647	0.5522	0.5498	0.5389	0.5389	0.5369	0.5431	0.5498	0.5546	0.5595 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			18.0000	1635.4800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	24733.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	82.5698	82.1757	81.7894	79.9750	79.6356	78.0553	78.0553	77.7627	78.6640	79.6356	80.3223	81.0402 (38)
Heat transfer coeff	205.5691	205.1750	204.7887	202.9743	202.6349	201.0546	201.0546	200.7620	201.6633	202.6349	203.3216	204.0395 (39)
Average = Sum(39)m / 12 =												202.9727 (39)
HLP	1.1214	1.1192	1.1171	1.1072	1.1054	1.0967	1.0967	1.0951	1.1001	1.1054	1.1091	1.1130 (40)
HLP (average)												1.1072 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

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Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	24.8768 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (64)
Heat gains from water heating, kWh/month	97.1113	86.0838	91.5605	83.6778	83.1602	75.9716	74.5463	79.6171	78.7924	86.6907	89.6550	95.3146 (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	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1734	28.5761	23.2397	17.5939	13.1517	11.1032	11.9974	15.5947	20.9311	26.5768	31.0191	33.0676 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.9030	358.5858	349.3053	329.5482	304.6084	281.1686	265.5093	261.8266	271.1070	290.8641	315.8039	339.2437 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008 (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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067 (71)
Water heating gains (Table 5)	130.5259	128.1009	123.0652	116.2191	111.7744	105.5160	100.1966	107.0122	109.4339	116.5197	124.5209	128.1111 (72)
Total internal gains	588.3048	585.9653	566.3126	534.0638	500.2370	468.4903	448.4058	455.1360	472.1745	504.6632	542.0463	571.1249 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					1.7000	10.6334	0.7100	0.7000			0.7700			6.2260 (74)
Northeast					1.8300	11.2829	0.7100	0.7000			0.7700			7.1115 (75)
Southeast					5.0000	36.7938	0.7100	0.7000			0.7700			63.3628 (77)
Southwest					1.1300	36.7938	0.7100	0.7000			0.7700			14.3200 (79)
West					1.7000	19.6403	0.7100	0.7000			0.7700			11.4997 (80)
Northwest					8.4500	11.2829	0.7100	0.7000			0.7700			32.8374 (81)
Southeast					14.1500	36.7938	0.7100	0.7000			0.7700			179.3168 (77)
Solar gains	314.6743	553.4768	802.7431	1069.2673	1264.6618	1284.6840	1226.4564	1076.4229	894.4760	624.0567	380.1118			267.2096 (83)
Total gains	902.9791	1139.4421	1369.0557	1603.3310	1764.8988	1753.1744	1674.8622	1531.5589	1366.6505	1128.7199	922.1582			838.3345 (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	33.4213	33.4855	33.5486	33.8485	33.9052	34.1717	34.1717	34.2215	34.0686	33.9052	33.7907	33.6718
alpha	3.2281	3.2324	3.2366	3.2566	3.2603	3.2781	3.2781	3.2814	3.2712	3.2603	3.2527	3.2448
util living area	0.9901	0.9788	0.9543	0.8966	0.7897	0.6374	0.4953	0.5516	0.7727	0.9348	0.9822	0.9922 (86)
MIT	18.9382	19.2221	19.6479	20.1696	20.5997	20.8616	20.9549	20.9356	20.7259	20.1415	19.4350	18.8867 (87)
Th 2	19.9834	19.9852	19.9869	19.9949	19.9965	20.0035	20.0035	20.0048	20.0008	19.9965	19.9934	19.9902 (88)
util rest of house	0.9881	0.9746	0.9452	0.8754	0.7463	0.5633	0.3954	0.4503	0.7104	0.9170	0.9781	0.9906 (89)
MIT 2	17.2101	17.6233	18.2388	18.9817	19.5616	19.8851	19.9771	19.9641	19.7386	18.9581	17.9409	17.1391 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	17.4472	17.8427	18.4321	19.1446	19.7040	20.0191	20.1113	20.0974	19.8740	19.1205	18.1459	17.3789 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.2972	17.6927	18.2821	18.9946	19.5540	19.8691	19.9613	19.9474	19.7240	18.9705	17.9959	17.2289 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9798	0.9607	0.9240	0.8490	0.7243	0.5524	0.3910	0.4440	0.6902	0.8923	0.9654	0.9837 (94)
Ext temp.	884.7754	1094.6784	1265.0102	1361.1829	1278.2922	968.4276	654.7960	680.0816	943.2290	1007.2075	890.2806	824.6624 (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)
	2671.8162	2624.7371	2412.8433	2048.9533	1591.4985	1059.3727	675.8033	712.1730	1134.1571	1696.1502	2215.3749	2658.4072 (97)

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Month fraction	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	1329.5584	1028.1994	853.9878	495.1947	233.0255	0.0000	0.0000	0.0000	0.0000	512.5733	954.0679	1364.3061 (98)
Space heating												6770.9132 (98)
Space heating per m2										(98) / (4) =		36.9349 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												7506.5556 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1329.5584	1028.1994	853.9878	495.1947	233.0255	0.0000	0.0000	0.0000	0.0000	512.5733	954.0679	1364.3061 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	1474.0115	1139.9107	946.7714	548.9964	258.3431	0.0000	0.0000	0.0000	0.0000	568.2631	1057.7249	1512.5345 (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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (64)
Efficiency of water heater	88.4993	88.3043	87.9116	87.0349	85.2097	79.5000	79.5000	79.5000	79.5000	87.0308	88.1332	79.5000 (216)
Fuel for water heating, kWh/month	250.2424	220.9743	232.9255	210.6496	210.6619	201.4616	193.2050	212.3882	212.1329	218.4543	228.4217	243.9410 (219)
Water heating fuel used												2635.4585 (219)
Annual totals kWh/year												
Space heating fuel - main system												7506.5556 (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)												568.1920 (232)
Energy saving/generation technologies (Appendices M, N and Q)												
PV Unit 0 (0.80 * 1.08 * 1029 * 1.00) =										-889.2173		-889.2173 (233)
Total delivered energy for all uses												9895.9888 (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	7506.5556	0.2160	1621.4160 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2635.4585	0.2160	569.2590 (264)
Space and water heating			2190.6751 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	568.1920	0.5190	294.8916 (268)
Energy saving/generation technologies			
PV Unit	-889.2173	0.5190	-461.5038 (269)
Total CO2, kg/year			2062.9879 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.2500 (273)

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

DER			11.2500 ZC1
Total Floor Area		TFA	183.3200
Assumed number of occupants		N	2.9802
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			11.4722 ZC2
CO2 emissions from cooking, equation (L16)			1.0393 ZC3
Total CO2 emissions			23.7615 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			23.7615 ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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) = 0.0911 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3411 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2900 (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	0.3697	0.3625	0.3552	0.3190	0.3117	0.2755	0.2755	0.2682	0.2900	0.3117	0.3262	0.3407 (22b)
Effective ac	0.5683	0.5657	0.5631	0.5509	0.5486	0.5379	0.5379	0.5360	0.5420	0.5486	0.5532	0.5580 (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			2.1300	1.0000	2.1300		(26)
TER Opening Type (Uw = 1.40)			33.9600	1.3258	45.0227		(27)
Heat Loss Floor 1			92.4600	0.1300	12.0198		(28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.1800	26.7246		(29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118		(30)
Bay	1.6000		1.6000	0.1300	0.2080		(30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	97.9169	(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)							15.5773 (36)
Total fabric heat loss						(33) + (36) =	113.4942 (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	82.3196	81.9352	81.5585	79.7888	79.4577	77.9164	77.9164	77.6310	78.5101	79.4577	80.1275	80.8278 (38)
Heat transfer coeff	195.8138	195.4295	195.0527	193.2831	192.9520	191.4107	191.4107	191.1252	192.0044	192.9520	193.6218	194.3220 (39)
Average = Sum(39)m / 12 =												193.2815 (39)
HLP	1.0682	1.0661	1.0640	1.0543	1.0525	1.0441	1.0441	1.0426	1.0474	1.0525	1.0562	1.0600 (40)
HLP (average)												1.0543 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)
Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	24.8768 (46)
Water storage loss:												250.0000 (47)
Store volume												1.8903 (48)
a) If manufacturer declared loss factor is known (kWh/day):												

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Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												1.0208 (55)	
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)	
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (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													
	226.1557	199.3686	209.4615	187.8802	184.1974	164.7036	158.2909	173.5416	173.1873	194.8155	205.8569	220.7522 (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													
	226.1557	199.3686	209.4615	187.8802	184.1974	164.7036	158.2909	173.5416	173.1873	194.8155	205.8569	220.7522 (64)	
								Total per year (kWh/year) = Sum(64)m =					2298.2113 (64)
Heat gains from water heating, kWh/month													
	100.8657	89.4749	95.3149	87.3111	86.9146	79.6048	78.3007	83.3715	82.4257	90.4451	93.2883	99.0690 (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	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1734	28.5761	23.2397	17.5939	13.1517	11.1032	11.9974	15.5947	20.9311	26.5768	31.0191	33.0676	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.9030	358.5858	349.3053	329.5482	304.6084	281.1686	265.5093	261.8266	271.1070	290.8641	315.8039	339.2437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	(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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	(71)
Water heating gains (Table 5)	135.5722	133.1472	128.1114	121.2654	116.8207	110.5623	105.2428	112.0585	114.4801	121.5659	129.5671	133.1573	(72)
Total internal gains	593.3510	591.0115	571.3588	539.1100	505.2833	473.5366	453.4520	460.1822	477.2208	509.7094	547.0926	576.1711	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
North				1.7000	10.6334	0.6300	0.7000	0.7700	5.5245 (74)				
Northeast				1.8300	11.2829	0.6300	0.7000	0.7700	6.3102 (75)				
Southeast				19.1500	36.7938	0.6300	0.7000	0.7700	215.3355 (77)				
Southwest				1.1300	36.7938	0.6300	0.7000	0.7700	12.7065 (79)				
West				1.7000	19.6403	0.6300	0.7000	0.7700	10.2039 (80)				
Northwest				8.4500	11.2829	0.6300	0.7000	0.7700	29.1374 (81)				
Solar gains	279.2181	491.1132	712.2931	948.7865	1122.1647	1139.9309	1088.2641	955.1358	793.6899	553.7405	337.2823	237.1015	(83)
Total gains	872.5691	1082.1248	1283.6520	1487.8964	1627.4479	1613.4675	1541.7162	1415.3180	1270.9107	1063.4499	884.3749	813.2726	(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	65.0136	65.1414	65.2673	65.8648	65.9778	66.5091	66.5091	66.6084	66.3035	65.9778	65.7496	65.5127
alpha	5.3342	5.3428	5.3512	5.3910	5.3985	5.4339	5.4339	5.4406	5.4202	5.3985	5.3833	5.3675
util living area	0.9994	0.9978	0.9920	0.9664	0.8818	0.7099	0.5368	0.6027	0.8612	0.9845	0.9983	0.9996 (86)
MIT	19.7529	19.9248	20.1907	20.5303	20.8126	20.9584	20.9924	20.9863	20.8798	20.4994	20.0574	19.7231 (87)
Th 2	20.0269	20.0286	20.0303	20.0383	20.0398	20.0467	20.0467	20.0480	20.0440	20.0398	20.0368	20.0336 (88)
util rest of house	0.9991	0.9970	0.9890	0.9535	0.8389	0.6235	0.4255	0.4873	0.7955	0.9765	0.9976	0.9994 (89)
MIT 2	18.3453	18.5979	18.9863	19.4776	19.8535	20.0187	20.0438	20.0422	19.9444	19.4416	18.7981	18.3065 (90)
Living area fraction	18.5384	18.7799	19.1516	19.6220	19.9851	20.1476	20.1740	20.1717	20.0728	19.5868	18.9709	18.5008 (91)
MIT	18.5384	18.7799	19.1516	19.6220	19.9851	20.1476	20.1740	20.1717	20.0728	19.5868	18.9709	18.5008 (92)
Temperature adjustment	18.5384	18.7799	19.1516	19.6220	19.9851	20.1476	20.1740	20.1717	20.0728	19.5868	18.9709	18.5008 (93)
adjusted MIT	18.5384	18.7799	19.1516	19.6220	19.9851	20.1476	20.1740	20.1717	20.0728	19.5868	18.9709	18.5008 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9986	0.9956	0.9852	0.9463	0.8361	0.6333	0.4407	0.5029	0.7978	0.9711	0.9964	0.9990	(94)
Ext temp.	871.3475	1077.3143	1264.7066	1407.9494	1360.6699	1021.7794	679.4702	711.7453	1013.9557	1032.7417	881.1859	812.4861	(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	2788.0753	2712.5454	2467.7240	2072.3875	1598.6169	1061.8791	684.0959	720.8705	1146.7955	1734.0121	2298.4598	2778.9696	(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	1426.0455	1098.8753	895.0449	478.3954	177.0326	0.0000	0.0000	0.0000	0.0000	521.7452	1020.4372	1463.0637	(98)
Space heating per m2											(98) / (4) =	38.6245	(99)

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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													7572.8768 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1426.0455	1098.8753	895.0449	478.3954	177.0326	0.0000	0.0000	0.0000	0.0000	521.7452	1020.4372	1463.0637	(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)	1525.1823	1175.2677	957.2673	511.6529	189.3396	0.0000	0.0000	0.0000	0.0000	558.0162	1091.3767	1564.7740	(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	226.1557	199.3686	209.4615	187.8802	184.1974	164.7036	158.2909	173.5416	173.1873	194.8155	205.8569	220.7522	(64)
Efficiency of water heater (217)m	88.8689	88.6741	88.2558	87.2029	84.7083	79.8000	79.8000	79.8000	79.8000	87.3169	88.5078	79.8000	(216)
Fuel for water heating, kWh/month	254.4823	224.8330	237.3346	215.4519	217.4491	206.3955	198.3596	217.4707	217.0267	223.1131	232.5861	248.2130	(219)
Water heating fuel used												2692.7154	(219)
Annual totals kWh/year													
Space heating fuel - main system												7572.8768	(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)												568.1920	(232)
Total delivered energy for all uses												10908.7841	(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	7572.8768	0.2160	1635.7414	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2692.7154	0.2160	581.6265	(264)
Space and water heating			2217.3679	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	568.1920	0.5190	294.8916	(268)
Total CO2, kg/m2/year			2551.1845	(272)
Emissions per m2 for space and water heating			12.0956	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.6086	(272b)
Emissions per m2 for pumps and fans			0.2123	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0956 * 1.00) + 1.6086 + 0.2123, rounded to 2 d.p.			13.9200	(273)

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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) = 0.0911 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3226 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2742 (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	0.3497	0.3428	0.3359	0.3017	0.2948	0.2605	0.2605	0.2537	0.2742	0.2948	0.3085	0.3222 (22b)
Effective ac	0.5611	0.5588	0.5564	0.5455	0.5435	0.5339	0.5339	0.5322	0.5376	0.5435	0.5476	0.5519 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			9.0000	817.7400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	23915.6400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							130.4584 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	81.2751	80.9313	80.5943	79.0114	78.7152	77.3366	77.3366	77.0813	77.8676	78.7152	79.3143	79.9407 (38)
Heat transfer coeff	204.2744	203.9306	203.5936	202.0107	201.7145	200.3359	200.3359	200.0806	200.8669	201.7145	202.3136	202.9400 (39)
Average = Sum(39)m / 12 =												202.0093 (39)
HLP	1.1143	1.1124	1.1106	1.1020	1.1003	1.0928	1.0928	1.0914	1.0957	1.1003	1.1036	1.1070 (40)
HLP (average)												1.1019 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

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Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (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	1651.7281 (45)
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	36.3904	31.8273	32.8429	28.6332	27.4743	23.7082	21.9691	25.2099	25.5110	29.7306	32.4533	35.2421 (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	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1734	28.5761	23.2397	17.5939	13.1517	11.1032	11.9974	15.5947	20.9311	26.5768	31.0191	33.0676 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.9030	358.5858	349.3053	329.5482	304.6084	281.1686	265.5093	261.8266	271.1070	290.8641	315.8039	339.2437 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008 (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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067 (71)
Water heating gains (Table 5)	48.9118	47.3620	44.1437	39.7684	36.9278	32.9281	29.5284	33.8843	35.4319	39.9605	45.0740	47.3685 (72)
Total internal gains	503.6907	502.2264	484.3911	454.6130	422.3904	392.9023	374.7376	379.0080	395.1726	425.1039	459.5995	487.3823 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.7000	10.6334	0.7100	0.7000	0.7700	6.2260 (74)
Northeast	1.8300	11.2829	0.7100	0.7000	0.7700	7.1115 (75)
Southeast	5.0000	36.7938	0.7100	0.7000	0.7700	63.3628 (77)
Southwest	1.1300	36.7938	0.7100	0.7000	0.7700	14.3200 (79)
West	1.7000	19.6403	0.7100	0.7000	0.7700	11.4997 (80)
Northwest	8.4500	11.2829	0.7100	0.7000	0.7700	32.8374 (81)
Southeast	14.1500	36.7938	0.7100	0.7000	0.7700	179.3168 (77)

Solar gains	314.6743	553.4768	802.7431	1069.2673	1264.6618	1284.6840	1226.4564	1076.4229	894.4760	624.0567	380.1118	267.2096 (83)
Total gains	818.3650	1055.7032	1287.1342	1523.8803	1687.0521	1677.5864	1601.1940	1455.4309	1289.6485	1049.1607	839.7113	754.5919 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	32.5211	32.5760	32.6299	32.8856	32.9338	33.1605	33.1605	33.2028	33.0728	32.9338	32.8363	32.7350
alpha	3.1681	3.1717	3.1753	3.1924	3.1956	3.2107	3.2107	3.2135	3.2049	3.1956	3.1891	3.1823
util living area	0.9917	0.9813	0.9583	0.9034	0.8004	0.6521	0.5109	0.5700	0.7889	0.9422	0.9850	0.9936 (86)
MIT	18.8360	19.1284	19.5679	20.1080	20.5607	20.8424	20.9469	20.9240	20.6915	20.0729	19.3425	18.7814 (87)
Th 2	19.9892	19.9907	19.9922	19.9992	20.0006	20.0067	20.0067	20.0078	20.0043	20.0006	19.9979	19.9951 (88)
util rest of house	0.9901	0.9777	0.9500	0.8836	0.7588	0.5789	0.4100	0.4683	0.7293	0.9265	0.9816	0.9923 (89)
MIT 2	17.9960	18.2873	18.7222	19.2509	19.6710	19.9129	19.9849	19.9741	19.7989	19.2281	18.5073	17.9459 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	18.1112	18.4027	18.8382	19.3685	19.7931	20.0404	20.1169	20.1044	19.9214	19.3440	18.6219	18.0605 (92)
Temperature adjustment												0.0000
adjusted MIT	18.1112	18.4027	18.8382	19.3685	19.7931	20.0404	20.1169	20.1044	19.9214	19.3440	18.6219	18.0605 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	806.7818	1024.0075	1207.1368	1323.5933	1263.5811	975.7270	675.3580	697.0111	933.2046	958.0309	818.7159	746.1712 (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	2821.2824	2753.6136	2511.9805	2114.7540	1632.4910	1089.9142	704.5517	741.1726	1169.3232	1763.7889	2331.0318	2812.8505 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1498.7885	1162.2953	970.8037	569.6357	274.4690	0.0000	0.0000	0.0000	0.0000	599.4840	1088.8674	1537.6094 (98)
Space heating												7701.9529 (98)
Space heating per m2										(98) / (4) =		42.0137 (99)

8c. Space cooling requirement

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Calculation Type: New Build (As Built)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1883.1572	1482.4854	1520.6123	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8018	0.8626	0.8292	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1509.9860	1278.7746	1260.8484	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2097.3839	2004.7894	1837.2779	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	422.9265	540.1550	428.8636	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			1391.9451	(104)
Intermittency factor (Table 10b)												1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	105.7316	135.0388	107.2159	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2												347.9863	(107)
Energy for space heating												1.8982	(108)
Energy for space cooling												42.0137	(99)
Total												1.8982	(108)
Dwelling Fabric Energy Efficiency (DFEE)												43.9120	(109)
												43.9	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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) = 0.0911 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3411 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2900 (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	0.3697	0.3625	0.3552	0.3190	0.3117	0.2755	0.2755	0.2682	0.2900	0.3117	0.3262	0.3407 (22b)
Effective ac	0.5683	0.5657	0.5631	0.5509	0.5486	0.5379	0.5379	0.5360	0.5420	0.5486	0.5532	0.5580 (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			2.1300	1.0000	2.1300		(26)
TER Opening Type (Uw = 1.40)			33.9600	1.3258	45.0227		(27)
Heat Loss Floor 1			92.4600	0.1300	12.0198		(28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.1800	26.7246		(29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118		(30)
Bay	1.6000		1.6000	0.1300	0.2080		(31)
Total net area of external elements Aum(A, m ²)			369.4800				(32)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	97.9169	(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)							15.5773 (36)
Total fabric heat loss						(33) + (36) =	113.4942 (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	82.3196	81.9352	81.5585	79.7888	79.4577	77.9164	77.9164	77.6310	78.5101	79.4577	80.1275	80.8278 (38)
Heat transfer coeff	195.8138	195.4295	195.0527	193.2831	192.9520	191.4107	191.4107	191.1252	192.0044	192.9520	193.6218	194.3220 (39)
Average = Sum(39)m / 12 =												193.2815 (39)
HLP	1.0682	1.0661	1.0640	1.0543	1.0525	1.0441	1.0441	1.0426	1.0474	1.0525	1.0562	1.0600 (40)
HLP (average)												1.0543 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)
Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m												1651.7281 (45)
Water 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 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

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If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	36.3904	31.8273	32.8429	28.6332	27.4743	23.7082	21.9691	25.2099	25.5110	29.7306	32.4533	(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	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	149.0084	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1734	28.5761	23.2397	17.5939	13.1517	11.1032	11.9974	15.5947	20.9311	26.5768	31.0191	33.0676	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.9030	358.5858	349.3053	329.5482	304.6084	281.1686	265.5093	261.8266	271.1070	290.8641	315.8039	339.2437	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	37.9008	(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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	(71)
Water heating gains (Table 5)	48.9118	47.3620	44.1437	39.7684	36.9278	32.9281	29.5284	33.8843	35.4319	39.9605	45.0740	47.3685	(72)
Total internal gains	503.6907	502.2264	484.3911	454.6130	422.3904	392.9023	374.7376	379.0080	395.1726	425.1039	459.5995	487.3823	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.7000	10.6334	0.6300	0.7000	0.7700	5.5245 (74)
Northeast	1.8300	11.2829	0.6300	0.7000	0.7700	6.3102 (75)
Southeast	19.1500	36.7938	0.6300	0.7000	0.7700	215.3355 (77)
Southwest	1.1300	36.7938	0.6300	0.7000	0.7700	12.7065 (79)
West	1.7000	19.6403	0.6300	0.7000	0.7700	10.2039 (80)
Northwest	8.4500	11.2829	0.6300	0.7000	0.7700	29.1374 (81)

Solar gains	279.2181	491.1132	712.2931	948.7865	1122.1647	1139.9309	1088.2641	955.1358	793.6899	553.7405	337.2823	237.1015	(83)
Total gains	782.9087	993.3396	1196.6842	1403.3994	1544.5550	1532.8332	1463.0017	1334.1438	1188.8625	978.8444	796.8818	724.4837	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.0136	65.1414	65.2673	65.8648	65.9778	66.5091	66.5091	66.6084	66.3035	65.9778	65.7496	65.5127	
alpha	5.3342	5.3428	5.3512	5.3910	5.3985	5.4339	5.4339	5.4406	5.4202	5.3985	5.3833	5.3675	
util living area	0.9996	0.9986	0.9942	0.9735	0.8995	0.7370	0.5632	0.6340	0.8861	0.9893	0.9990	0.9998	(86)
MIT	19.7064	19.8791	20.1472	20.4929	20.7887	20.9502	20.9904	20.9826	20.8583	20.4584	20.0122	19.6769	(87)
Th 2	20.0269	20.0286	20.0303	20.0383	20.0398	20.0467	20.0467	20.0480	20.0440	20.0398	20.0368	20.0336	(88)
util rest of house	0.9995	0.9980	0.9920	0.9629	0.8605	0.6509	0.4477	0.5152	0.8265	0.9835	0.9986	0.9997	(89)
MIT 2	18.8323	19.0062	19.2746	19.6204	19.8937	20.0233	20.0442	20.0428	19.9612	19.5919	19.1460	18.8083	(90)
Living area fraction									fLA = Living area / (4) =			0.1372	(91)
MIT	18.9522	19.1260	19.3943	19.7401	20.0165	20.1505	20.1740	20.1718	20.0843	19.7108	19.2648	18.9275	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9522	19.1260	19.3943	19.7401	20.0165	20.1505	20.1740	20.1718	20.0843	19.7108	19.2648	18.9275	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9993	0.9974	0.9901	0.9588	0.8594	0.6611	0.4636	0.5314	0.8295	0.9808	0.9981	0.9995	(94)
Ext temp.	782.3506	990.7234	1184.7925	1345.5158	1327.3331	1013.2896	678.2067	709.0171	986.1553	960.0132	795.3375	724.1441	(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	2869.1119	2780.1700	2515.0763	2095.2104	1604.6788	1062.4195	684.1056	720.8787	1149.0068	1757.9422	2355.3701	2861.8706	(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 per m2	1552.5504	1202.5128	989.7311	539.7802	206.3452	0.0000	0.0000	0.0000	0.0000	593.6591	1123.2234	1590.4685	(98)
												7798.2707	(98)
												42.5391	(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	1799.2603	1416.4389	1452.5518	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8722	0.9322	0.9021	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1569.4022	1320.4099	1310.2827	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1928.1919	1843.2660	1695.5138	0.0000	0.0000	0.0000	0.0000	(103)

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Month fraction	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	258.3286	389.0049	286.6120	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												933.9455 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling												0.0000 (107)
Space cooling per m2												233.4864 (107)
Energy for space heating												1.2737 (108)
Energy for space cooling												42.5391 (99)
Total												1.2737 (108)
Target Fabric Energy Efficiency (TFEE)												43.8128 (109)
												50.4 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1139 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3454 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.2936 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3083	0.2863	0.2936	0.2789	0.2789	0.2716	0.2642	0.2569	0.2496	0.2716	0.2569	0.2716 (22b)
Effective ac	0.5475	0.5410	0.5431	0.5389	0.5389	0.5369	0.5349	0.5330	0.5311	0.5369	0.5330	0.5369 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			18.0000	1635.4800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	24733.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	79.3039	78.3558	78.6640	78.0553	78.0553	77.7627	77.4778	77.2008	76.9316	77.7627	77.2008	77.7627 (38)
Heat transfer coeff	202.3032	201.3551	201.6633	201.0546	201.0546	200.7620	200.4771	200.2001	199.9309	200.7620	200.2001	200.7620 (39)
Average = Sum(39)m / 12 =												200.8771 (39)
HLP	1.1036	1.0984	1.1001	1.0967	1.0967	1.0951	1.0936	1.0921	1.0906	1.0951	1.0921	1.0951 (40)
HLP (average)												1.0958 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Energy content (annual)										Total =	Sum (45)m =	1651.7281 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	24.8768 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss												
	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage												
	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (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												
	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (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												
	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (64)
										Total per year (kWh/year) =	Sum (64)m =	2242.9551 (64)
												2243 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month												
	97.1113	86.0838	91.5605	83.6778	83.1602	75.9716	74.5463	79.6171	78.7924	86.6907	89.6550	95.3146 (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	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	80.4335	71.4403	58.0991	43.9848	32.8791	27.7580	29.9935	38.9866	52.3278	66.4421	77.5478	82.6690 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	529.7059	535.2026	521.3511	491.8630	454.6395	419.6546	396.2826	390.7859	404.6374	434.1255	471.3491	506.3339 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612 (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)												
	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067 (71)
Water heating gains (Table 5)												
	130.5259	128.1009	123.0652	116.2191	111.7744	105.5160	100.1966	107.0122	109.4339	116.5197	124.5209	128.1111 (72)
Total internal gains												
	859.1298	853.2084	820.9800	770.5314	717.7576	671.3931	644.9372	655.2493	684.8635	735.5519	791.8822	835.5784 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W
North					1.7000	13.4839		0.7100	0.7000	0.7700	7.8950 (74)	
Northeast					1.8300	14.6176		0.7100	0.7000	0.7700	9.2134 (75)	
Southeast					5.0000	45.1778		0.7100	0.7000	0.7700	77.8010 (77)	
Southwest					1.1300	45.1778		0.7100	0.7000	0.7700	17.5830 (79)	
West					1.7000	25.1925		0.7100	0.7000	0.7700	14.7506 (80)	
Northwest					8.4500	14.6176		0.7100	0.7000	0.7700	42.5426 (81)	
Southeast					14.1500	45.1778		0.7100	0.7000	0.7700	220.1767 (77)	

Solar gains	389.9623	585.1238	859.8570	1160.1146	1310.0675	1447.9599	1370.5839	1228.4490	1014.6392	712.9763	469.7876	325.3656 (83)
Total gains	1249.0921	1438.3322	1680.8370	1930.6460	2027.8251	2119.3530	2015.5211	1883.6983	1699.5027	1448.5282	1261.6698	1160.9440 (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	33.9608	34.1207	34.0686	34.1717	34.1717	34.2215	34.2702	34.3176	34.3638	34.2215	34.3176	34.2215
alpha	3.2641	3.2747	3.2712	3.2781	3.2781	3.2814	3.2847	3.2878	3.2909	3.2814	3.2878	3.2814
util living area												
	0.9725	0.9572	0.9167	0.8301	0.6970	0.5045	0.3771	0.4008	0.6422	0.8621	0.9511	0.9771 (86)
MIT	19.3330	19.5412	19.9522	20.4197	20.7583	20.9386	20.9822	20.9788	20.8622	20.4447	19.8349	19.2998 (87)
Th 2	19.9979	20.0022	20.0008	20.0035	20.0035	20.0048	20.0061	20.0073	20.0085	20.0048	20.0073	20.0048 (88)
util rest of house												
	0.9674	0.9493	0.9014	0.7994	0.6433	0.4277	0.2856	0.3045	0.5671	0.8289	0.9403	0.9726 (89)
MIT 2	17.7910	18.0925	18.6764	19.3225	19.7590	19.9591	19.9976	19.9971	19.8914	19.3734	18.5229	17.7479 (90)
Living area fraction												
	18.0025	18.2913	18.8514	19.4730	19.8961	20.0935	20.1327	20.1318	20.0246	19.5204	18.7029	17.9608 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8525	18.1413	18.7014	19.3230	19.7461	19.9435	19.9827	19.9818	19.8746	19.3704	18.5529	17.8108 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9513	0.9292	0.8761	0.7749	0.6281	0.4227	0.2833	0.3019	0.5560	0.8030	0.9187	0.9583 (94)
Useful gains	1188.2863	1336.5227	1472.5293	1496.0039	1273.5827	895.8873	571.0713	568.7007	944.8677	1163.2315	1159.1539	1112.5076 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	2620.3357	2585.6589	2359.7509	1974.9688	1456.8698	932.2372	577.9129	576.9319	1034.5616	1600.1571	2132.7149	2571.9205	(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	1065.4448	839.4195	660.0929	344.8547	136.3656	0.0000	0.0000	0.0000	0.0000	325.0726	700.9639	1085.8032	(98)
RHI space heating demand												5158.0172	(98)
												5158	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1139 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3454 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2936 (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	0.3743	0.3670	0.3597	0.3230	0.3156	0.2789	0.2789	0.2716	0.2936	0.3156	0.3303	0.3450 (22b)
Effective ac	0.5701	0.5673	0.5647	0.5522	0.5498	0.5389	0.5389	0.5369	0.5431	0.5498	0.5546	0.5595 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			18.0000	1635.4800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	24733.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	82.5698	82.1757	81.7894	79.9750	79.6356	78.0553	78.0553	77.7627	78.6640	79.6356	80.3223	81.0402 (38)
Heat transfer coeff	205.5691	205.1750	204.7887	202.9743	202.6349	201.0546	201.0546	200.7620	201.6633	202.6349	203.3216	204.0395 (39)
Average = Sum(39)m / 12 =												202.9727 (39)
HLP	1.1214	1.1192	1.1171	1.1072	1.1054	1.0967	1.0967	1.0951	1.1001	1.1054	1.1091	1.1130 (40)
HLP (average)												1.1072 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	24.8768 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (64)
Total per year (kWh/year) = Sum(64)m =												2242.9551 (64)
Heat gains from water heating, kWh/month	97.1113	86.0838	91.5605	83.6778	83.1602	75.9716	74.5463	79.6171	78.7924	86.6907	89.6550	95.3146 (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	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.4335	71.4403	58.0991	43.9848	32.8791	27.7580	29.9935	38.9866	52.3278	66.4421	77.5478	82.6690 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	529.7059	535.2026	521.3511	491.8630	454.6395	419.6546	396.2826	390.7859	404.6374	434.1255	471.3491	506.3339 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612 (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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067 (71)
Water heating gains (Table 5)	130.5259	128.1009	123.0652	116.2191	111.7744	105.5160	100.1966	107.0122	109.4339	116.5197	124.5209	128.1111 (72)
Total internal gains	859.1298	853.2084	820.9800	770.5314	717.7576	671.3931	644.9372	655.2493	684.8635	735.5519	791.8822	835.5784 (73)

6. Solar gains

[Jan]												
				Area	Solar flux		g		FF		Access	Gains
				m2	Table 6a		Specific data		Specific data		factor	W
					W/m2		or Table 6b		or Table 6c		Table 6d	
North				1.7000	10.6334		0.7100		0.7000		0.7700	6.2260 (74)
Northeast				1.8300	11.2829		0.7100		0.7000		0.7700	7.1115 (75)
Southeast				5.0000	36.7938		0.7100		0.7000		0.7700	63.3628 (77)
Southwest				1.1300	36.7938		0.7100		0.7000		0.7700	14.3200 (79)
West				1.7000	19.6403		0.7100		0.7000		0.7700	11.4997 (80)
Northwest				8.4500	11.2829		0.7100		0.7000		0.7700	32.8374 (81)
Southeast				14.1500	36.7938		0.7100		0.7000		0.7700	179.3168 (77)
Solar gains	314.6743	553.4768	802.7431	1069.2673	1264.6618	1284.6840	1226.4564	1076.4229	894.4760	624.0567	380.1118	267.2096 (83)
Total gains	1173.8042	1406.6852	1623.7230	1839.7987	1982.4193	1956.0772	1871.3935	1731.6722	1579.3395	1359.6086	1171.9940	1102.7880 (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	33.4213	33.4855	33.5486	33.8485	33.9052	34.1717	34.1717	34.2215	34.0686	33.9052	33.7907	33.6718
alpha	3.2281	3.2324	3.2366	3.2566	3.2603	3.2781	3.2781	3.2814	3.2712	3.2603	3.2527	3.2448
util living area	0.9792	0.9626	0.9304	0.8616	0.7455	0.5894	0.4504	0.4994	0.7153	0.8994	0.9658	0.9827 (86)
MIT	19.1456	19.4162	19.8139	20.2899	20.6683	20.8905	20.9659	20.9519	20.7861	20.2784	19.6193	19.0919 (87)
Th 2	19.9834	19.9852	19.9869	19.9949	19.9965	20.0035	20.0035	20.0048	20.0008	19.9965	19.9934	19.9902 (88)
util rest of house	0.9753	0.9558	0.9175	0.8358	0.6988	0.5163	0.3570	0.4037	0.6486	0.8748	0.9583	0.9795 (89)
MIT 2	17.5105	17.9018	18.4718	19.1419	19.6430	19.9119	19.9840	19.9753	19.8025	19.1425	18.2050	17.4369 (90)
Living area fraction									fLA = Living area / (4) =			0.1372 (91)
MIT	17.7348	18.1095	18.6560	19.2994	19.7836	20.0462	20.1187	20.1093	19.9375	19.2984	18.3990	17.6639 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5848	17.9595	18.5060	19.1494	19.6336	19.8962	19.9687	19.9593	19.7875	19.1484	18.2490	17.5139 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9616	0.9367	0.8929	0.8097	0.6798	0.5079	0.3536	0.3991	0.6325	0.8483	0.9399	0.9674 (94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	2730.9393	2679.4903	2458.6864	2080.3635	1607.6304	1064.8219	677.2970	714.5635	1146.9543	1732.1994	2266.8355	2716.5646 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	1192.0662	915.1736	750.6444	425.2509	193.3831	0.0000	0.0000	0.0000	0.0000	430.6821	839.0314	1227.3814 (98)
Space heating												5973.6131 (98)
Space heating per m2										(98) / (4) =		32.5857 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												6622.6310 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1192.0662	915.1736	750.6444	425.2509	193.3831	0.0000	0.0000	0.0000	0.0000	430.6821	839.0314	1227.3814 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	1321.5812	1014.6049	832.2000	471.4533	214.3937	0.0000	0.0000	0.0000	0.0000	477.4746	930.1901	1360.7333 (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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (64)
Efficiency of water heater (217)m	88.3372	88.1157	87.6710	86.6853	84.7115	79.5000	79.5000	79.5000	79.5000	86.6292	87.9104	79.5000 (216)
Fuel for water heating, kWh/month	250.7014	221.4471	233.5647	211.4991	211.9010	201.4616	193.2050	212.3882	212.1329	219.4668	229.0004	244.3591 (219)
Water heating fuel used												2641.1273 (219)
Annual totals kWh/year												
Space heating fuel - main system												6622.6310 (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)												568.1920 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.08 * 1029 * 1.00) =										-889.2173		-889.2173 (233)
Total delivered energy for all uses												9017.7329 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	6622.6310	3.4800	230.4676 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2641.1273	3.4800	91.9112 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	568.1920	13.1900	74.9445 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-889.2173	13.1900	-117.2878 (252)
Total energy cost			409.9280 (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] =	0.7541 (257)
SAP value		89.4807
SAP rating (Section 12)		89 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6622.6310	0.2160	1430.4883 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2641.1273	0.2160	570.4835 (264)
Space and water heating			2000.9718 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	568.1920	0.5190	294.8916 (268)
Energy saving/generation technologies			
PV Unit	-889.2173	0.5190	-461.5038 (269)
Total kg/year			1873.2846 (272)

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	10.2200 (273)
EI value	89.0058
EI rating	89 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9020 = 3.858$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9020 = 0.2395$, stars = 4
Water heating energy efficiency	$3.48 / 0.8471 = 4.108$, stars = 4
Water heating environmental impact	$0.216 / 0.8471 = 0.2550$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1139 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3454 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.2936 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3083	0.2863	0.2936	0.2789	0.2789	0.2716	0.2642	0.2569	0.2496	0.2716	0.2569	0.2716 (22b)
Effective ac	0.5475	0.5410	0.5431	0.5389	0.5389	0.5369	0.5349	0.5330	0.5311	0.5369	0.5330	0.5369 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			18.0000	1635.4800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	24733.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	79.3039	78.3558	78.6640	78.0553	78.0553	77.7627	77.4778	77.2008	76.9316	77.7627	77.2008	77.7627 (38)
Heat transfer coeff	202.3032	201.3551	201.6633	201.0546	201.0546	200.7620	200.4771	200.2001	199.9309	200.7620	200.2001	200.7620 (39)
Average = Sum(39)m / 12 =												200.8771 (39)
HLP	1.1036	1.0984	1.1001	1.0967	1.0967	1.0951	1.0936	1.0921	1.0906	1.0951	1.0921	1.0951 (40)
HLP (average)												1.0958 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	24.8768 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592 (64)
Heat gains from water heating, kWh/month	97.1113	86.0838	91.5605	83.6778	83.1602	75.9716	74.5463	79.6171	78.7924	86.6907	89.6550	95.3146 (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	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.4335	71.4403	58.0991	43.9848	32.8791	27.7580	29.9935	38.9866	52.3278	66.4421	77.5478	82.6690 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	529.7059	535.2026	521.3511	491.8630	454.6395	419.6546	396.2826	390.7859	404.6374	434.1255	471.3491	506.3339 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612 (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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067 (71)
Water heating gains (Table 5)	130.5259	128.1009	123.0652	116.2191	111.7744	105.5160	100.1966	107.0122	109.4339	116.5197	124.5209	128.1111 (72)
Total internal gains	859.1298	853.2084	820.9800	770.5314	717.7576	671.3931	644.9372	655.2493	684.8635	735.5519	791.8822	835.5784 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North				1.7000	13.4839	0.7100	0.7000		0.7700		7.8950 (74)	
Northeast				1.8300	14.6176	0.7100	0.7000		0.7700		9.2134 (75)	
Southeast				5.0000	45.1778	0.7100	0.7000		0.7700		77.8010 (77)	
Southwest				1.1300	45.1778	0.7100	0.7000		0.7700		17.5830 (79)	
West				1.7000	25.1925	0.7100	0.7000		0.7700		14.7506 (80)	
Northwest				8.4500	14.6176	0.7100	0.7000		0.7700		42.5426 (81)	
Southeast				14.1500	45.1778	0.7100	0.7000		0.7700		220.1767 (77)	
Solar gains	389.9623	585.1238	859.8570	1160.1146	1310.0675	1447.9599	1370.5839	1228.4490	1014.6392	712.9763	469.7876	325.3656 (83)
Total gains	1249.0921	1438.3322	1680.8370	1930.6460	2027.8251	2119.3530	2015.5211	1883.6983	1699.5027	1448.5282	1261.6698	1160.9440 (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	33.9608	34.1207	34.0686	34.1717	34.1717	34.2215	34.2702	34.3176	34.3638	34.2215	34.3176	34.2215
alpha	3.2641	3.2747	3.2712	3.2781	3.2781	3.2814	3.2847	3.2878	3.2909	3.2814	3.2878	3.2814
util living area	0.9725	0.9572	0.9167	0.8301	0.6970	0.5045	0.3771	0.4008	0.6422	0.8621	0.9511	0.9771 (86)
MIT	19.3330	19.5412	19.9522	20.4197	20.7583	20.9386	20.9822	20.9788	20.8622	20.4447	19.8349	19.2998 (87)
Th 2	19.9979	20.0022	20.0008	20.0035	20.0035	20.0048	20.0061	20.0073	20.0085	20.0048	20.0073	20.0048 (88)
util rest of house	0.9674	0.9493	0.9014	0.7994	0.6433	0.4277	0.2856	0.3045	0.5671	0.8289	0.9403	0.9726 (89)
MIT 2	17.7910	18.0925	18.6764	19.3225	19.7590	19.9591	19.9976	19.9971	19.8914	19.3734	18.5229	17.7479 (90)
Living area fraction	18.0025	18.2913	18.8514	19.4730	19.8961	20.0935	20.1327	20.1318	20.0246	19.5204	18.7029	17.9608 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8525	18.1413	18.7014	19.3230	19.7461	19.9435	19.9827	19.9818	19.8746	19.3704	18.5529	17.8108 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9513	0.9292	0.8761	0.7749	0.6281	0.4227	0.2833	0.3019	0.5560	0.8030	0.9187	0.9583 (94)
Ext temp.	1188.2863	1336.5227	1472.5293	1496.0039	1273.5827	895.8873	571.0713	568.7007	944.8677	1163.2315	1159.1539	1112.5076 (95)
Heat loss rate W	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
	2620.3357	2585.6589	2359.7509	1974.9688	1456.8698	932.2372	577.9129	576.9319	1034.5616	1600.1571	2132.7149	2571.9205 (97)

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Month fraction	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	1065.4448	839.4195	660.0929	344.8547	136.3656	0.0000	0.0000	0.0000	0.0000	325.0726	700.9639	1085.8032	(98)
Space heating												5158.0172	(98)
Space heating per m2											(98) / (4) =	28.1367	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.2000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													5718.4226	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1065.4448	839.4195	660.0929	344.8547	136.3656	0.0000	0.0000	0.0000	0.0000	325.0726	700.9639	1085.8032	(98)	
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)	
Space heating fuel (main heating system)	1181.2026	930.6203	731.8103	382.3223	151.1814	0.0000	0.0000	0.0000	0.0000	360.3909	777.1218	1203.7730	(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	221.4627	195.1298	204.7686	183.3386	179.5044	160.1620	153.5979	168.8486	168.6457	190.1225	201.3152	216.0592	(64)	
Efficiency of water heater (217)m	88.1581	87.9669	87.4144	86.1742	83.7911	79.5000	79.5000	79.5000	79.5000	85.9319	87.5703	79.5000	(216)	
Fuel for water heating, kWh/month	251.2108	221.8218	234.2503	212.7535	214.2284	201.4616	193.2050	212.3882	212.1329	221.2478	229.8899	244.8839	(219)	
Water heating fuel used												2649.4741	(219)	
Annual totals kWh/year														
Space heating fuel - main system												5718.4226	(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)												568.1920	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 1.08 * 1156 * 1.00) =										-998.9833		-998.9833	(233)	
Total delivered energy for all uses												8012.1054	(238)	

10a. Fuel costs - using BEDF prices (443)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5718.4226	3.9200	224.1622	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2649.4741	3.9200	103.8594	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	568.1920	16.9600	96.3654	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-998.9833	16.9600	-169.4276	(252)
Total energy cost			355.6793	(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	5718.4226	0.2160	1235.1793	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2649.4741	0.2160	572.2864	(264)
Space and water heating			1807.4657	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	568.1920	0.5190	294.8916	(268)
Energy saving/generation technologies				
PV Unit	-998.9833	0.5190	-518.4723	(269)
Total kg/year			1622.8100	(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	5718.4226	1.2200	6976.4756	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2649.4741	1.2200	3232.3584	(264)

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Space and water heating			10208.8340 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	568.1920	3.0700	1744.3494 (268)
Energy saving/generation technologies			
PV Unit	-998.9833	3.0700	-3066.8788 (269)
Primary energy kWh/year			9116.5547 (272)
Primary energy kWh/m2/year			49.7303 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 45	-270 kg (16.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£45 1.47 kg/m²	B 90	B 91
Total Savings	£45 1.47 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 443 TEST (28 May 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£109	£118	-£8
Mains gas	£416	£362	£54
Space heating	£325	£326	-£1
Water heating	£104	£57	£47
Lighting	£96	£96	£0
Generated (PV)	-£169	-£169	£0
Total cost of fuels	£356	£311	£46
Total cost of uses	£356	£310	£46
Delivered energy	44 kWh/m²	36 kWh/m²	7 kWh/m²
Carbon dioxide emissions	1.6 tonnes	1.4 tonnes	0.3 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	1 kg/m²
Primary energy	50 kWh/m²	41 kWh/m²	8 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1139 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3454 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2936 (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	0.3743	0.3670	0.3597	0.3230	0.3156	0.2789	0.2789	0.2716	0.2936	0.3156	0.3303	0.3450 (22b)
Effective ac	0.5701	0.5673	0.5647	0.5522	0.5498	0.5389	0.5389	0.5369	0.5431	0.5498	0.5546	0.5595 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			18.0000	1635.4800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	24733.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	82.5698	82.1757	81.7894	79.9750	79.6356	78.0553	78.0553	77.7627	78.6640	79.6356	80.3223	81.0402 (38)
Heat transfer coeff	205.5691	205.1750	204.7887	202.9743	202.6349	201.0546	201.0546	200.7620	201.6633	202.6349	203.3216	204.0395 (39)
Average = Sum(39)m / 12 =												202.9727 (39)
HLP	1.1214	1.1192	1.1171	1.1072	1.1054	1.0967	1.0967	1.0951	1.1001	1.1054	1.1091	1.1130 (40)
HLP (average)												1.1072 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

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Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	1651.7281 (45)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage	18.8660	17.0402	18.8660	18.2574	18.8660	18.2574	18.8660	18.8660	18.2574	18.8660	18.2574	18.8660 (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	213.3773	187.8268	195.2874	168.7604	158.6247	139.7307	132.4856	148.6667	155.4182	180.6413	193.4906	207.9738 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.0980 (H8)
Utilisation factor												0.5978 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												127.5000 (H13)
Daily hot water demand												104.9790 (H14)
Volume ratio Veff/V												1.2145 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-953.2653 (H17)
Solar input	-27.6428	-46.1279	-78.5610	-105.2873	-130.0736	-127.8830	-126.1930	-110.2555	-86.3521	-58.9684	-32.7883	-23.1323 (63)
Solar input (sum of months) = Sum(63)m =												-953.2653 (63)
Output from w/h	185.7345	141.6989	116.7263	63.4731	28.5511	11.8476	6.2926	38.4113	69.0661	121.6729	160.7023	184.8415 (64)
Total per year (kWh/year) = Sum(64)m =												1129.0181 (64)
Heat gains from water heating, kWh/month	90.6430	80.2415	83.9756	72.0152	66.4564	59.6265	57.6564	63.4716	68.2104	79.1057	83.3953	88.8463 (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	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.4335	71.4403	58.0991	43.9848	32.8791	27.7580	29.9935	38.9866	52.3278	66.4421	77.5478	82.6690	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	529.7059	535.2026	521.3511	491.8630	454.6395	419.6546	396.2826	390.7859	404.6374	434.1255	471.3491	506.3339	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	(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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	(71)
Water heating gains (Table 5)	121.8319	119.4069	112.8704	100.0211	89.3231	82.8146	77.4951	85.3113	94.7367	106.3249	115.8269	119.4171	(72)
Total internal gains	850.4358	844.5144	810.7852	754.3334	695.3062	648.6917	622.2357	633.5484	670.1663	725.3571	783.1882	826.8844	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North				1.7000	10.6334	0.7100	0.7000		0.7700		6.2260 (74)	
Northeast				1.8300	11.2829	0.7100	0.7000		0.7700		7.1115 (75)	
Southeast				5.0000	36.7938	0.7100	0.7000		0.7700		63.3628 (77)	
Southwest				1.1300	36.7938	0.7100	0.7000		0.7700		14.3200 (79)	
West				1.7000	19.6403	0.7100	0.7000		0.7700		11.4997 (80)	
Northwest				8.4500	11.2829	0.7100	0.7000		0.7700		32.8374 (81)	
Southeast				14.1500	36.7938	0.7100	0.7000		0.7700		179.3168 (77)	
Solar gains	314.6743	553.4768	802.7431	1069.2673	1264.6618	1284.6840	1226.4564	1076.4229	894.4760	624.0567	380.1118	267.2096 (83)
Total gains	1165.1102	1397.9912	1613.5282	1823.6007	1959.9680	1933.3757	1848.6921	1709.9713	1564.6423	1349.4138	1163.3000	1094.0940 (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	33.4213	33.4855	33.5486	33.8485	33.9052	34.1717	34.1717	34.2215	34.0686	33.9052	33.7907	33.6718	
alpha	3.2281	3.2324	3.2366	3.2566	3.2603	3.2781	3.2781	3.2814	3.2712	3.2603	3.2527	3.2448	
util living area	0.9796	0.9632	0.9314	0.8641	0.7500	0.5945	0.4553	0.5046	0.7191	0.9011	0.9664	0.9831	(86)
MIT	19.1391	19.4101	19.8076	20.2822	20.6619	20.8877	20.9648	20.9504	20.7824	20.2728	19.6131	19.0853	(87)
Th 2	19.9834	19.9852	19.9869	19.9949	19.9965	20.0035	20.0035	20.0048	20.0008	19.9965	19.9934	19.9902	(88)
util rest of house													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	0.9758	0.9565	0.9187	0.8386	0.7036	0.5213	0.3610	0.4083	0.6526	0.8768	0.9591	0.9799 (89)
Living area fraction	17.5011	17.8930	18.4630	19.1317	19.6354	19.9093	19.9833	19.9743	19.7987	19.1351	18.1961	17.4273 (90)
MIT	17.7258	18.1012	18.6475	19.2896	19.7762	20.0435	20.1180	20.1082	fLA = Living area / (4) =			0.1372 (91)
Temperature adjustment									19.9337	19.2911	18.3905	17.6547 (92)
adjusted MIT	17.5758	17.9512	18.4975	19.1396	19.6262	19.8935	19.9680	19.9582	19.7837	19.1411	18.2405	-0.1500
												17.5047 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9622	0.9375	0.8942	0.8124	0.6843	0.5126	0.3575	0.4035	0.6363	0.8503	0.9408	0.9680	(94)
Useful gains	1121.1192	1310.6668	1442.7452	1481.5337	1341.1878	990.9923	660.9824	690.0498	995.5766	1147.3601	1094.4836	1059.1259	(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	2729.0884	2677.7722	2456.9452	2078.3714	1606.1305	1064.2921	677.1516	714.3473	1146.1937	1730.7327	2265.1116	2714.6942	(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	1196.3291	918.6949	754.5647	429.7231	197.1173	0.0000	0.0000	0.0000	0.0000	434.0292	842.8522	1231.7428	(98)
Space heating												6005.0533	(98)
Space heating per m2										(98) / (4) =		32.7572	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													6657.4871 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1196.3291	918.6949	754.5647	429.7231	197.1173	0.0000	0.0000	0.0000	0.0000	434.0292	842.8522	1231.7428	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	1326.3072	1018.5087	836.5463	476.4115	218.5336	0.0000	0.0000	0.0000	0.0000	481.1854	934.4259	1365.5685	(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	185.7345	141.6989	116.7263	63.4731	28.5511	11.8476	6.2926	38.4113	69.0661	121.6729	160.7023	184.8415	(64)
Efficiency of water heater (217)m	88.5975	88.6064	88.6024	88.6642	88.6898	79.5000	79.5000	79.5000	79.5000	87.6180	88.2970	79.5000	(216)
Fuel for water heating, kWh/month	209.6385	159.9195	131.7417	71.5882	32.1921	14.9027	7.9152	48.3161	86.8755	138.8676	182.0021	208.5229	(219)
Water heating fuel used												1292.4820	(219)
Annual totals kWh/year													
Space heating fuel - main system												6657.4871	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												568.1920	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.08 * 1029 * 1.00) =										-889.2173		-889.2173	(233)
Total delivered energy for all uses												7753.9437	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6657.4871	3.4800	231.6805	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1292.4820	3.4800	44.9784	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	568.1920	13.1900	74.9445	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-889.2173	13.1900	-117.2878	(252)
Total energy cost			370.8032	(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] =	0.6821 (257)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value 90.4847
 SAP rating (Section 12) 90 (258)
 SAP band B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6657.4871	0.2160	1438.0172 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1292.4820	0.2160	279.1761 (264)
Space and water heating			1717.1933 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	568.1920	0.5190	294.8916 (268)
Energy saving/generation technologies			
PV Unit	-889.2173	0.5190	-461.5038 (269)
Total kg/year			1615.4562 (272)
CO2 emissions per m2			8.8100 (273)
EI value			90.5190
EI rating			91 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	92.4600 (1b)	x 2.3100 (2b)	= 213.5826 (1b) - (3b)
First floor	90.8600 (1c)	x 2.4800 (2c)	= 225.3328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	183.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 438.9154 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1139 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3454 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2936 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3083	0.2863	0.2936	0.2789	0.2789	0.2716	0.2642	0.2569	0.2496	0.2716	0.2569	0.2716 (22b)
Effective ac	0.5475	0.5410	0.5431	0.5389	0.5389	0.5369	0.5349	0.5330	0.5311	0.5369	0.5330	0.5369 (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			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			19.8100	1.3258	26.2633		(27)
French (Uw = 1.40)			14.1500	1.3258	18.7595		(27)
Heat Loss Floor 1			92.4600	0.1500	13.8690	75.0000	6934.5000 (28a)
100mm Knauf Supafil	184.5600	36.0900	148.4700	0.2500	37.1175	60.0000	8908.2000 (29a)
External Roof 1	90.8600		90.8600	0.1300	11.8118	9.0000	817.7400 (30)
Bay	1.6000		1.6000	0.1300	0.2080	9.0000	14.4000 (30)
Total net area of external elements Aum(A, m ²)			369.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	109.9460		(33)
GF			62.5600			39.0000	2439.8400 (32c)
GF			72.5200			9.0000	652.6800 (32c)
FF			188.3400			9.0000	1695.0600 (32c)
Internal Floor 1			90.8600			18.0000	1635.4800 (32d)
Internal Floor 1			90.8600			18.0000	1635.4800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	24733.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0533 (36)
Total fabric heat loss						(33) + (36) =	122.9993 (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	79.3039	78.3558	78.6640	78.0553	78.0553	77.7627	77.4778	77.2008	76.9316	77.7627	77.2008	77.7627 (38)
Heat transfer coeff	202.3032	201.3551	201.6633	201.0546	201.0546	200.7620	200.4771	200.2001	199.9309	200.7620	200.2001	200.7620 (39)
Average = Sum(39)m / 12 =												200.8771 (39)
HLP	1.1036	1.0984	1.1001	1.0967	1.0967	1.0951	1.0936	1.0921	1.0906	1.0951	1.0921	1.0951 (40)
HLP (average)												1.0958 (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												2.9802 (42)
Average daily hot water use (litres/day)												104.9790 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.4769	111.2777	107.0786	102.8794	98.6802	94.4811	94.4811	98.6802	102.8794	107.0786	111.2777	115.4769 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Energy content (annual)	171.2489	149.7754	154.5548	134.7446	129.2906	111.5680	103.3841	118.6348	120.0517	139.9087	152.7212	165.8454 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6873	22.4663	23.1832	20.2117	19.3936	16.7352	15.5076	17.7952	18.0078	20.9863	22.9082	1651.7281 (45)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage	18.8660	17.0402	18.8660	18.2574	18.8660	18.2574	18.8660	18.8660	18.2574	18.8660	18.2574	18.8660 (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	213.3773	187.8268	195.2874	168.7604	158.6247	139.7307	132.4856	148.6667	155.4182	180.6413	193.4906	207.9738 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2288 (H8)
Utilisation factor												0.5568 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												127.5000 (H13)
Daily hot water demand												104.9790 (H14)
Volume ratio Veff/V												1.2145 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-993.7567 (H17)
Solar input	-32.4187	-46.0974	-79.2303	-106.9001	-125.5606	-134.1185	-131.2980	-117.5157	-92.0067	-63.6103	-38.3428	-26.6576 (63)
Solar input (sum of months) = Sum(63)m =												-993.7567 (63)
Output from w/h	180.9585	141.7294	116.0570	61.8603	33.0641	5.6121	1.1876	31.1511	63.4115	117.0310	155.1478	181.3161 (64)
Total per year (kWh/year) = Sum(64)m =												1088.5266 (64)
Heat gains from water heating, kWh/month	90.6430	80.2415	83.9756	72.0152	66.4564	59.6265	57.6564	63.4716	68.2104	79.1057	83.3953	88.8463 (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	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	178.8100	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.4335	71.4403	58.0991	43.9848	32.8791	27.7580	29.9935	38.9866	52.3278	66.4421	77.5478	82.6690	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	529.7059	535.2026	521.3511	491.8630	454.6395	419.6546	396.2826	390.7859	404.6374	434.1255	471.3491	506.3339	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	55.8612	(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)	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	-119.2067	(71)
Water heating gains (Table 5)	121.8319	119.4069	112.8704	100.0211	89.3231	82.8146	77.4951	85.3113	94.7367	106.3249	115.8269	119.4171	(72)
Total internal gains	850.4358	844.5144	810.7852	754.3334	695.3062	648.6917	622.2357	633.5484	670.1663	725.3571	783.1882	826.8844	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				1.7000	13.4839		0.7100		0.7000		0.7700		7.8950 (74)
Northeast				1.8300	14.6176		0.7100		0.7000		0.7700		9.2134 (75)
Southeast				5.0000	45.1778		0.7100		0.7000		0.7700		77.8010 (77)
Southwest				1.1300	45.1778		0.7100		0.7000		0.7700		17.5830 (79)
West				1.7000	25.1925		0.7100		0.7000		0.7700		14.7506 (80)
Northwest				8.4500	14.6176		0.7100		0.7000		0.7700		42.5426 (81)
Southeast				14.1500	45.1778		0.7100		0.7000		0.7700		220.1767 (77)
Solar gains	389.9623	585.1238	859.8570	1160.1146	1310.0675	1447.9599	1370.5839	1228.4490	1014.6392	712.9763	469.7876	325.3656	(83)
Total gains	1240.3981	1429.6382	1670.6422	1914.4480	2005.3737	2096.6516	1992.8196	1861.9973	1684.8055	1438.3334	1252.9758	1152.2500	(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	33.9608	34.1207	34.0686	34.1717	34.1717	34.2215	34.2702	34.3176	34.3638	34.2215	34.3176	34.2215
alpha	3.2641	3.2747	3.2712	3.2781	3.2781	3.2814	3.2847	3.2878	3.2909	3.2814	3.2878	3.2814
util living area	0.9731	0.9578	0.9179	0.8328	0.7017	0.5091	0.3811	0.4050	0.6460	0.8640	0.9519	0.9775 (86)
MIT	19.3266	19.5352	19.9461	20.4129	20.7532	20.9370	20.9817	20.9782	20.8597	20.4399	19.8290	19.2933 (87)
Th 2	19.9979	20.0022	20.0008	20.0035	20.0035	20.0048	20.0061	20.0073	20.0085	20.0048	20.0073	20.0048 (88)
util rest of house												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

MIT 2	0.9680	0.9501	0.9027	0.8023	0.6482	0.4318	0.2887	0.3079	0.5709	0.8312	0.9414	0.9732 (89)
Living area fraction	17.7818	18.0840	18.6681	19.3138	19.7534	19.9578	19.9973	19.9967	19.8891	19.3672	18.5146	17.7385 (90)
MIT	17.9937	18.2831	18.8434	19.4646	19.8906	20.0921	20.1324	20.1314	fLA = Living area / (4) =			0.1372 (91)
Temperature adjustment									20.0222	19.5144	18.6950	17.9518 (92)
adjusted MIT	17.8437	18.1331	18.6934	19.3146	19.7406	19.9421	19.9824	19.9814	19.8722	19.3644	18.5450	-0.1500
												17.8018 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9521	0.9301	0.8775	0.7777	0.6326	0.4267	0.2864	0.3052	0.5595	0.8053	0.9199	0.9590 (94)	
Useful gains	1180.9770	1329.7545	1465.9424	1488.8885	1268.5884	894.6146	570.7817	568.3489	942.7167	1158.2226	1152.6298	1105.0235 (95)	
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)	
Heat loss rate W	2618.5598	2584.0058	2358.1347	1973.2757	1455.7518	931.9666	577.8487	576.8540	1034.0895	1598.9490	2131.1229	2570.1189 (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	1069.5617	842.8569	663.7910	348.7588	139.2496	0.0000	0.0000	0.0000	0.0000	327.9004	704.5150	1090.0310 (98)	
Space heating												5186.6644 (98)	
Space heating per m2										(98) / (4) =		28.2930 (99)	

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5750.1822 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1069.5617	842.8569	663.7910	348.7588	139.2496	0.0000	0.0000	0.0000	0.0000	327.9004	704.5150	1090.0310 (98)	
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)	
Space heating fuel (main heating system)	1185.7668	934.4312	735.9102	386.6505	154.3787	0.0000	0.0000	0.0000	0.0000	363.5260	781.0588	1208.4601 (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	180.9585	141.7294	116.0570	61.8603	33.0641	5.6121	1.1876	31.1511	63.4115	117.0310	155.1478	181.3161 (64)	
Efficiency of water heater (217)m	88.4768	88.4857	88.4288	88.4074	87.9292	79.5000	79.5000	79.5000	79.5000	87.1159	88.0610	79.5000 (216)	
Fuel for water heating, kWh/month	204.5265	160.1722	131.2435	69.9718	37.6031	7.0593	1.4938	39.1837	79.7629	134.3394	176.1823	204.8742 (219)	
Water heating fuel used												1246.4127 (219)	
Annual totals kWh/year													
Space heating fuel - main system												5750.1822 (211)	
Space heating fuel - secondary												0.0000 (215)	
Electricity for pumps and fans:													
central heating pump												30.0000 (230c)	
main heating flue fan												45.0000 (230e)	
pump for solar water heating												50.0000 (230g)	
Total electricity for the above, kWh/year												125.0000 (231)	
Electricity for lighting (calculated in Appendix L)												568.1920 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.08 * 1156 * 1.00) =									-998.9833			-998.9833 (233)	
Total delivered energy for all uses												6690.8036 (238)	

10a. Fuel costs - using BEDF prices (443)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5750.1822	3.9200	225.4071 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1246.4127	3.9200	48.8594 (247)	
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)	
Pump for solar water heating	50.0000	16.9600	8.4800 (249)	
Energy for lighting	568.1920	16.9600	96.3654 (250)	
Additional standing charges			88.0000 (251)	
Energy saving/generation technologies				
PV Unit	-998.9833	16.9600	-169.4276 (252)	
Total energy cost			310.4043 (255)	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Space heating - main system 1	5750.1822	0.2160	1242.0394 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1246.4127	0.2160	269.2252 (264)
Space and water heating			1511.2645 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	568.1920	0.5190	294.8916 (268)
Energy saving/generation technologies			
PV Unit	-998.9833	0.5190	-518.4723 (269)
Total kg/year			1352.5588 (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	5750.1822	1.2200	7015.2223 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1246.4127	1.2200	1520.6235 (264)
Space and water heating			8535.8459 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	568.1920	3.0700	1744.3494 (268)
Energy saving/generation technologies			
PV Unit	-998.9833	3.0700	-3066.8788 (269)
Primary energy kWh/year			7597.0665 (272)
Primary energy kWh/m2/year			41.4416 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	134.9 (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	579.37 (P1)
Transmission heat loss coefficient	123.00 (P7)
Summer heat loss coefficient	702.37 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.7000	87.1704	0.7100	0.7000	0.9000	59.6567
North East	1.8300	106.0502	0.7100	0.7000	0.9000	78.1275
South East	5.0000	127.3119	0.7100	0.7000	0.9000	256.2597
South West	1.1300	127.3119	0.7100	0.7000	0.9000	57.9147
West	1.7000	125.2818	0.7100	0.7000	0.9000	85.7390
North West	8.4500	106.0502	0.7100	0.7000	0.9000	360.7528
South East	14.1500	127.3119	0.7100	0.7000	0.9000	725.2149
total:						1623.6652

	Jun	Jul	Aug	
Solar gains	1744	1624	1450	(P3)
Internal gains	668	642	652	
Total summer gains	2412	2266	2103	(P5)
Summer gain/loss ratio	3.43	3.23	2.99	(P6)
Summer external temperature	15.40	17.30	17.30	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



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

Thermal mass temperature increment (TMP = 134.9)	1.06	1.06	1.06	
Threshold temperature	19.89	21.58	21.35	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			