

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-162			Issued on Date	15/03/2018
Assessment Reference	As Built	Prop Type Ref	P508-A - Det (As)		
Property	81, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE				
SAP Rating	89 B	DER	12.41	TER	15.59
Environmental	89 B	% DER<TER	20.41		
CO ₂ Emissions (t/year)	1.41	DFEE	47.81	TFEE	54.52
General Requirements Compliance	Pass	% DFEE<TFEE	12.30		
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 146 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) 15.59 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.41 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)54.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.8 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	1.36 (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: 4.53 (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 15 Heat 15

Efficiency: 89.2% SEDBUK2009
Minimum: 88.0%

OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.42 kWh/day
Permitted by DBSCG 2.30 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: 0.69 m², No overhang
Windows facing North East: 10.28 m², No overhang
Windows facing South East: 1.13 m², No overhang
Windows facing South: 1.30 m², No overhang
Windows facing South West: 9.26 m², No overhang
Windows facing West: 1.99 m², No overhang
Windows facing North West: 2.36 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Door U-value 0.90 W/m²K
Thermal bridging y-value 0.037 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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 350.1306 (5)
Dwelling volume			

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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					4.5300
Infiltration rate					0.3407 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3407 (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	0.4344	0.4259	0.4174	0.3748	0.3663	0.3237	0.3237	0.3152	0.3407	0.3663	0.3833	0.4004 (22b)
Effective ac	0.5944	0.5907	0.5871	0.5702	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5801 (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)			21.9100	1.3258	29.0473		(27)
French (Uw = 1.40)			4.1000	1.3258	5.4356		(27)
Jet Floor			73.5000	0.1500	11.0250	75.0000	5512.5000 (28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000 (29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800 (30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 92.7225		(33)
GF - Timber			51.6100			9.0000	464.4900 (32c)
GF - Metal			9.8400			20.0000	196.8000 (32c)
GF - Masonry			40.4700			39.0000	1578.3300 (32c)
1F - Timber			99.9900			9.0000	899.9100 (32c)
1F - Metal			51.2900			20.0000	1025.8000 (32c)
Internal Floor			72.7400			18.0000	1309.3200 (32d)
Internal Floor			72.7400			18.0000	1309.3200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21536.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							147.2861 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.8395 (36)
Total fabric heat loss							(33) + (36) = 104.5620 (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	68.6756	68.2522	67.8372	65.8878	65.5230	63.8252	63.8252	63.5108	64.4792	65.5230	66.2609	67.0322 (38)
Heat transfer coeff	173.2376	172.8142	172.3991	170.4497	170.0850	168.3871	168.3871	168.0727	169.0411	170.0850	170.8228	171.5942 (39)
Average = Sum(39)m / 12 =												170.4480 (39)
HLP	1.1848	1.1819	1.1790	1.1657	1.1632	1.1516	1.1516	1.1495	1.1561	1.1632	1.1683	1.1735 (40)
HLP (average)												1.1657 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m	25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
Heat gains from water heating, kWh/month	93.8962	83.1991	88.4108	80.6877	80.1094	73.0723	71.5969	76.6081	75.8599	83.5983	86.5946	92.1207 (65)
Total per year (kWh/year) = Sum(64)m =												2186.0532 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.8632	25.6360	20.8486	15.7837	11.7985	9.9608	10.7630	13.9902	18.7776	23.8424	27.8276	29.6654 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.3799	319.6630	311.3898	293.7773	271.5446	250.6491	236.6896	233.4065	241.6797	259.2922	281.5249	302.4204 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405 (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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244 (71)
Water heating gains (Table 5)	126.2046	123.8081	118.8317	112.0663	107.6739	101.4892	96.2324	102.9678	105.3609	112.3633	120.2702	123.8182 (72)
Total internal gains	541.3693	539.0288	520.9918	491.5490	460.9387	432.0208	413.6067	420.2862	435.7398	465.4196	499.5444	525.8256 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.6900	10.6334	0.7100	0.7000	0.7700	2.5270 (74)
Northeast	6.1800	11.2829	0.7100	0.7000	0.7700	24.0160 (75)
Southeast	1.1300	36.7938	0.7100	0.7000	0.7700	14.3200 (77)
South	1.3000	46.7521	0.7100	0.7000	0.7700	20.9331 (78)
Southwest	8.2600	36.7938	0.7100	0.7000	0.7700	104.6754 (79)
West	1.9900	19.6403	0.7100	0.7000	0.7700	13.4614 (80)
Northwest	2.3600	11.2829	0.7100	0.7000	0.7700	9.1712 (81)
Northeast	4.1000	11.2829	0.7100	0.7000	0.7700	15.9329 (75)

Solar gains	205.0370	368.1242	552.7194	765.2613	929.2702	953.9273	906.6553	779.7274	625.7227	420.1820	249.0499	173.2140 (83)
Total gains	746.4064	907.1530	1073.7112	1256.8103	1390.2089	1385.9481	1320.2619	1200.0136	1061.4625	885.6016	748.5943	699.0396 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.5322	34.6168	34.7001	35.0970	35.1722	35.5269	35.5269	35.5933	35.3894	35.1722	35.0203	34.8629
alpha	3.3021	3.3078	3.3133	3.3398	3.3448	3.3685	3.3685	3.3729	3.3593	3.3448	3.3347	3.3242
util living area	0.9915	0.9833	0.9644	0.9154	0.8168	0.6664	0.5229	0.5833	0.8055	0.9481	0.9853	0.9932 (86)
MIT	18.9710	19.2172	19.6179	20.1362	20.5770	20.8535	20.9520	20.9304	20.7043	20.1192	19.4506	18.9313 (87)
Th 2	19.9322	19.9345	19.9368	19.9475	19.9495	19.9589	19.9589	19.9607	19.9553	19.9495	19.9455	19.9412 (88)
util rest of house	0.9897	0.9797	0.9564	0.8958	0.7734	0.5879	0.4140	0.4736	0.7430	0.9321	0.9816	0.9917 (89)
MIT 2	17.2138	17.5732	18.1541	18.8970	19.4942	19.8369	19.9324	19.9186	19.6755	18.8879	17.9220	17.1614 (90)
Living area fraction									fLA = Living area / (4) =			0.1578 (91)
MIT	17.4911	17.8326	18.3850	19.0925	19.6651	19.9973	20.0932	20.0783	19.8378	19.0821	18.1632	17.4406 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3411	17.6826	18.2350	18.9425	19.5151	19.8473	19.9432	19.9283	19.6878	18.9321	18.0132	17.2906 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9826	0.9683	0.9385	0.8717	0.7523	0.5785	0.4122	0.4699	0.7238	0.9106	0.9709	0.9857 (94)
	733.3971	878.3773	1007.6535	1095.5884	1045.8289	801.8306	544.2180	563.8389	768.2571	806.3993	726.8022	689.0360 (95)

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Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	2259.2051	2209.0100	2023.1095	1711.7430	1329.2272	883.5728	562.9571	593.0079	944.5703	1417.1703	1864.2166	2246.2773 (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	1135.2012	894.1851	755.4993	443.6313	210.8484	0.0000	0.0000	0.0000	0.0000	454.4136	818.9384	1158.5876 (98)
Space heating												5871.3048 (98)
Space heating per m2											(98) / (4) =	40.1539 (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												6509.2071 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1135.2012	894.1851	755.4993	443.6313	210.8484	0.0000	0.0000	0.0000	0.0000	454.4136	818.9384	1158.5876 (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)	1258.5379	991.3361	837.5823	491.8307	233.7565	0.0000	0.0000	0.0000	0.0000	503.7845	907.9140	1284.4651 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
Efficiency of water heater	88.2983	88.1172	87.7307	86.8441	85.0137	79.5000	79.5000	79.5000	79.5000	86.8155	87.9109	79.5000 (216)
Fuel for water heating, kWh/month	244.9258	216.1815	227.7055	205.7408	205.6152	195.9371	187.6726	206.6299	206.4828	213.4344	223.4519	238.6892 (219)
Water heating fuel used												2572.4667 (219)
Annual totals kWh/year												
Space heating fuel - main system												6509.2071 (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)												509.7324 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.08 * 1004 * 1.00) =									-867.4527			-867.4527 (233)
Total delivered energy for all uses												8798.9535 (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	6509.2071	0.2160	1405.9887 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2572.4667	0.2160	555.6528 (264)
Space and water heating			1961.6415 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	509.7324	0.5190	264.5511 (268)
Energy saving/generation technologies			
PV Unit	-867.4527	0.5190	-450.2080 (269)
Total CO2, kg/year			1814.9097 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.4100 (273)

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

DER			12.4100 ZC1
Total Floor Area		TFA	146.2200
Assumed number of occupants		N	2.9281
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			12.8218 ZC2
CO2 emissions from cooking, equation (L16)			1.2945 ZC3
Total CO2 emissions			26.5262 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			26.5262 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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.1306 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																4 * 10 =	40.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000	/ (5) =	0.1142 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3642 (18)							
Number of sides sheltered										0 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =							1.0000 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.3642 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)				
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)				
	0.4644	0.4553	0.4462	0.4007	0.3916	0.3460	0.3460	0.3369	0.3642	0.3916	0.4098	0.4280	(22b)				
Effective ac	0.6078	0.6037	0.5995	0.5803	0.5767	0.5599	0.5599	0.5568	0.5663	0.5767	0.5840	0.5916	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opaque door			2.1300	1.0000	2.1300			(26)					
TER Opening Type (Uw = 1.40)			26.0100	1.3258	34.4830			(27)					
Jet Floor			73.5000	0.1300	9.5550			(28a)					
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.1800	25.7346			(29a)					
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236			(30)					
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314			(30)					
Total net area of external elements Aum(A, m2)			318.1100					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	81.4576			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								13.8943 (36)					
Total fabric heat loss						(33) + (36) =		95.3519 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 70.2315	Feb 69.7477	Mar 69.2734	Apr 67.0459	May 66.6291	Jun 64.6890	Jul 64.6890	Aug 64.3297	Sep 65.4363	Oct 66.6291	Nov 67.4722	Dec 68.3537	(38)
Heat transfer coeff	165.5834	165.0995	164.6253	162.3977	161.9810	160.0408	160.0408	159.6815	160.7881	161.9810	162.8241	163.7055	(39)
Average = Sum(39)m / 12 =												162.3957	(39)
HLP	Jan 1.1324	Feb 1.1291	Mar 1.1259	Apr 1.1106	May 1.1078	Jun 1.0945	Jul 1.0945	Aug 1.0921	Sep 1.0996	Oct 1.1078	Nov 1.1136	Dec 1.1196	(40)
HLP (average)												1.1106	(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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Daily hot water use	Jan 114.1169	Feb 109.9672	Mar 105.8175	Apr 101.6678	May 97.5181	Jun 93.3683	Jul 93.3683	Aug 97.5181	Sep 101.6678	Oct 105.8175	Nov 109.9672	Dec 114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)										Total = Sum(45)m =		1632.2752 (45)
Distribution loss (46)m = 0.15 x (45)m	25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)
Water storage loss:												210.0000 (47)
Store volume												1.7016 (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)													0.9188 (55)
Total storage loss													
28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	27.5653	(56)
If cylinder contains dedicated solar storage													
28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	27.5653	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	(59)
Total heat required for water heating calculated for each month													
220.9786	194.7503	204.4811	183.2350	179.5145	160.3314	153.9131	168.9842	168.7151	190.0075	200.9999	215.6388	200.9999	(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 =													(63)
Output from w/h													
220.9786	194.7503	204.4811	183.2350	179.5145	160.3314	153.9131	168.9842	168.7151	190.0075	200.9999	215.6388	200.9999	(64)
Heat gains from water heating, kWh/month													
97.6669	86.6049	92.1815	84.3368	83.8801	76.7213	75.3676	80.3788	79.5089	87.3690	90.2436	95.8914	95.8914	(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	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
28.8632	25.6360	20.8486	15.7837	11.7985	9.9608	10.7630	13.9902	18.7776	23.8424	27.8276	29.6654	29.6654	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
316.3799	319.6630	311.3898	293.7773	271.5446	250.6491	236.6896	233.4065	241.6797	259.2922	281.5249	302.4204	302.4204	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	(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)													
-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	(71)
Water heating gains (Table 5)													
131.2727	128.8763	123.8999	117.1344	112.7421	106.5574	101.3006	108.0360	110.4291	117.4315	125.3384	128.8863	128.8863	(72)
Total internal gains													
546.4375	544.0969	526.0599	496.6171	466.0069	437.0889	418.6748	425.3543	440.8080	470.4878	504.6125	530.8937	530.8937	(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	0.6900	10.6334	0.6300	0.7000	0.7700	2.2423	(74)						
Northeast	10.2800	11.2829	0.6300	0.7000	0.7700	35.4476	(75)						
Southeast	1.1300	36.7938	0.6300	0.7000	0.7700	12.7065	(77)						
South	1.3000	46.7521	0.6300	0.7000	0.7700	18.5745	(78)						
Southwest	8.2600	36.7938	0.6300	0.7000	0.7700	92.8810	(79)						
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446	(80)						
Northwest	2.3600	11.2829	0.6300	0.7000	0.7700	8.1378	(81)						
Solar gains	181.9343	326.6454	490.4411	679.0347	824.5637	846.4425	804.4969	691.8708	555.2187	372.8376	220.9880	153.6969	(83)
Total gains	728.3718	870.7424	1016.5011	1175.6518	1290.5706	1283.5315	1223.1718	1117.2251	996.0267	843.3253	725.6005	684.5907	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	61.3236	61.5033	61.6805	62.5265	62.6874	63.4474	63.4474	63.5901	63.1525	62.6874	62.3628	62.0270	
alpha	5.0882	5.1002	5.1120	5.1684	5.1792	5.2298	5.2298	5.2393	5.2102	5.1792	5.1575	5.1351	
util living area													
0.9992	0.9977	0.9927	0.9705	0.8955	0.7324	0.5616	0.6305	0.8806	0.9859	0.9981	0.9994	0.9994	(86)
MIT	19.6871	19.8463	20.1110	20.4669	20.7730	20.9454	20.9888	20.9804	20.8494	20.4478	20.0049	19.6656	(87)
Th 2	19.9744	19.9771	19.9798	19.9922	19.9945	20.0053	20.0053	20.0073	20.0011	19.9945	19.9898	19.9849	(88)
util rest of house													
0.9989	0.9969	0.9899	0.9588	0.8545	0.6435	0.4419	0.5077	0.8179	0.9785	0.9973	0.9992	0.9992	(89)
MIT 2	18.2116	18.4462	18.8337	19.3534	19.7663	19.9681	20.0011	19.9989	19.8738	19.3341	18.6875	18.1875	(90)
Living area fraction													
MIT	18.4444	18.6671	19.0353	19.5290	19.9251	20.1223	20.1569	20.1538	20.0277	19.5098	18.8953	18.4207	(91)
Temperature adjustment													
adjusted MIT	18.4444	18.6671	19.0353	19.5290	19.9251	20.1223	20.1569	20.1538	20.0277	19.5098	18.8953	18.4207	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9982	0.9954	0.9862	0.9517	0.8512	0.6548	0.4608	0.5268	0.8199	0.9733	0.9959	0.9987	0.9987	(94)
Useful gains	727.0537	866.7050	1002.4994	1118.8267	1098.5396	840.4485	563.6344	588.5476	816.6828	820.8227	722.6119	683.6894	(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													
2342.0828	2272.9470	2063.6199	1726.1328	1332.3127	883.7888	569.2554	599.4113	953.1041	1443.2240	1920.5648	2328.0077	2328.0077	(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													
1201.5817	944.9946	789.4736	437.2604	173.9272	0.0000	0.0000	0.0000	0.0000	463.0666	862.5261	1223.3728	1223.3728	(98)
Space heating													
Space heating per m2													
													(98) / (4) = 41.6920 (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													6520.0032	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1201.5817	944.9946	789.4736	437.2604	173.9272	0.0000	0.0000	0.0000	0.0000	463.0666	862.5261	1223.3728	(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)	1285.1141	1010.6895	844.3568	467.6582	186.0184	0.0000	0.0000	0.0000	0.0000	495.2584	922.4878	1308.4201	(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	220.9786	194.7503	204.4811	183.2350	179.5145	160.3314	153.9131	168.9842	168.7151	190.0075	200.9999	215.6388	(64)	
Efficiency of water heater (217)m	88.6535	88.4730	88.0706	87.0531	84.7297	79.8000	79.8000	79.8000	79.8000	87.1020	88.2633	88.7174	(217)	
Fuel for water heating, kWh/month	249.2611	220.1240	232.1786	210.4866	211.8673	200.9165	192.8736	211.7596	211.4225	218.1436	227.7277	243.0625	(219)	
Water heating fuel used												2629.8236	(219)	
Annual totals kWh/year														
Space heating fuel - main system												6520.0032	(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)												509.7324	(232)	
Total delivered energy for all uses												9734.5592	(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	6520.0032	0.2160	1408.3207 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2629.8236	0.2160	568.0419 (264)
Space and water heating			1976.3626 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	509.7324	0.5190	264.5511 (268)
Total CO2, kg/m2/year			2279.8387 (272)
Emissions per m2 for space and water heating			13.5164 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.8093 (272b)
Emissions per m2 for pumps and fans			0.2662 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.5164 * 1.00) + 1.8093 + 0.2662, rounded to 2 d.p.			15.5900 (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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.1306 (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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					4.5300
Infiltration rate					0.3407 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3407 (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	0.4344	0.4259	0.4174	0.3748	0.3663	0.3237	0.3237	0.3152	0.3407	0.3663	0.3833	0.4004 (22b)
Effective ac	0.5944	0.5907	0.5871	0.5702	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5801 (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)			21.9100	1.3258	29.0473		(27)
French (Uw = 1.40)			4.1000	1.3258	5.4356		(27)
Jet Floor			73.5000	0.1500	11.0250	75.0000	5512.5000 (28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000 (29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800 (30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	92.7225	(33)
GF - Timber			51.6100			9.0000	464.4900 (32c)
GF - Metal			9.8400			20.0000	196.8000 (32c)
GF - Masonry			40.4700			39.0000	1578.3300 (32c)
1F - Timber			99.9900			9.0000	899.9100 (32c)
1F - Metal			51.2900			20.0000	1025.8000 (32c)
Internal Floor			72.7400			18.0000	1309.3200 (32d)
Internal Floor			72.7400			9.0000	654.6600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	20881.5100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							142.8088 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.8395 (36)
Total fabric heat loss						(33) + (36) =	104.5620 (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	68.6756	68.2522	67.8372	65.8878	65.5230	63.8252	63.8252	63.5108	64.4792	65.5230	66.2609	67.0322 (38)
Heat transfer coeff	173.2376	172.8142	172.3991	170.4497	170.0850	168.3871	168.3871	168.0727	169.0411	170.0850	170.8228	171.5942 (39)
Average = Sum(39)m / 12 =												170.4480 (39)
HLP	1.1848	1.1819	1.1790	1.1657	1.1632	1.1516	1.1516	1.1495	1.1561	1.1632	1.1683	1.1735 (40)
HLP (average)												1.1657 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.9618	31.4524	32.4561	28.2960	27.1507	23.4290	21.7104	24.9130	25.2105	29.3804	32.0711	34.8271 (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	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.8632	25.6360	20.8486	15.7837	11.7985	9.9608	10.7630	13.9902	18.7776	23.8424	27.8276	29.6654	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.3799	319.6630	311.3898	293.7773	271.5446	250.6491	236.6896	233.4065	241.6797	259.2922	281.5249	302.4204	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	(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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	(71)
Water heating gains (Table 5)	48.3358	46.8042	43.6238	39.3000	36.4929	32.5402	29.1806	33.4852	35.0146	39.4898	44.5431	46.8106	(72)
Total internal gains	460.5005	459.0248	442.7839	415.7827	386.7577	360.0718	343.5548	347.8035	362.3935	389.5461	420.8173	445.8180	(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				0.6900	10.6334		0.7100		0.7000		0.7700		2.5270 (74)
Northeast				6.1800	11.2829		0.7100		0.7000		0.7700		24.0160 (75)
Southeast				1.1300	36.7938		0.7100		0.7000		0.7700		14.3200 (77)
South				1.3000	46.7521		0.7100		0.7000		0.7700		20.9331 (78)
Southwest				8.2600	36.7938		0.7100		0.7000		0.7700		104.6754 (79)
West				1.9900	19.6403		0.7100		0.7000		0.7700		13.4614 (80)
Northwest				2.3600	11.2829		0.7100		0.7000		0.7700		9.1712 (81)
Northeast				4.1000	11.2829		0.7100		0.7000		0.7700		15.9329 (75)
Solar gains	205.0370	368.1242	552.7194	765.2613	929.2702	953.9273	906.6553	779.7274	625.7227	420.1820	249.0499	173.2140	(83)
Total gains	665.5375	827.1491	995.5032	1181.0440	1316.0278	1313.9991	1250.2101	1127.5309	988.1162	809.7282	669.8672	619.0320	(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	33.4825	33.5645	33.6453	34.0301	34.1031	34.4469	34.4469	34.5114	34.3137	34.1031	33.9558	33.8031	
alpha	3.2322	3.2376	3.2430	3.2687	3.2735	3.2965	3.2965	3.3008	3.2876	3.2735	3.2637	3.2535	
util living area	0.9933	0.9861	0.9690	0.9239	0.8310	0.6863	0.5445	0.6084	0.8259	0.9565	0.9884	0.9947 (86)	
MIT	18.8519	19.1058	19.5202	20.0603	20.5274	20.8292	20.9416	20.9153	20.6602	20.0373	19.3446	18.8115 (87)	
Th 2	19.9322	19.9345	19.9368	19.9475	19.9495	19.9589	19.9589	19.9607	19.9553	19.9495	19.9455	19.9412 (88)	
util rest of house	0.9919	0.9831	0.9621	0.9060	0.7899	0.6089	0.4336	0.4978	0.7674	0.9429	0.9855	0.9936 (89)	
MIT 2	17.9612	18.2153	18.6271	19.1610	19.5976	19.8596	19.9361	19.9246	19.7308	19.1492	18.4623	17.9274 (90)	
Living area fraction									fLA = Living area / (4) =			0.1578 (91)	
MIT	18.1018	18.3558	18.7680	19.3029	19.7443	20.0126	20.0948	20.0809	19.8774	19.2893	18.6015	18.0669 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.1018	18.3558	18.7680	19.3029	19.7443	20.0126	20.0948	20.0809	19.8774	19.2893	18.6015	18.0669 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9884	0.9770	0.9521	0.8926	0.7807	0.6133	0.4491	0.5117	0.7623	0.9317	0.9801	0.9907 (94)	
Useful gains	657.8057	808.1491	947.8004	1054.1692	1027.3829	805.8927	561.4336	577.0010	753.2023	754.4309	656.5572	613.2816 (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	2390.9849	2325.3461	2114.9943	1773.1705	1368.2102	911.4117	588.4758	618.6554	976.6183	1477.9248	1964.7162	2379.4823 (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	1289.4853	1019.5563	868.3923	517.6809	253.5755	0.0000	0.0000	0.0000	0.0000	538.2795	941.8745	1314.0533 (98)	
Space heating												6742.8977 (98)	
Space heating per m2												(98) / (4) = 46.1147 (99)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1582.8390	1246.0647	1277.3526	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7853	0.8495	0.8117	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1242.9974	1058.5209	1036.8712	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1660.5843	1583.1421	1442.2572	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	300.6626	390.3181	301.6072	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			992.5880	(104)
Intermittency factor (Table 10b)												1.0000	(105)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	75.1656	97.5795	75.4018	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2												248.1470	(107)
Energy for space heating												1.6971	(108)
Energy for space cooling												46.1147	(99)
Total												1.6971	(108)
Dwelling Fabric Energy Efficiency (DFEE)												47.8118	(109)
												47.8	(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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 350.1306 (5)
Dwelling volume			

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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3642 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3642 (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	0.4644	0.4553	0.4462	0.4007	0.3916	0.3460	0.3460	0.3369	0.3642	0.3916	0.4098	0.4280 (22b)
Effective ac	0.6078	0.6037	0.5995	0.5803	0.5767	0.5599	0.5599	0.5568	0.5663	0.5767	0.5840	0.5916 (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)			26.0100	1.3258	34.4830		(27)
Jet Floor			73.5000	0.1300	9.5550		(28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.1800	25.7346		(29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236		(30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314		(30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	81.4576		(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)							13.8943 (36)
Total fabric heat loss						(33) + (36) =	95.3519 (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	70.2315	69.7477	69.2734	67.0459	66.6291	64.6890	64.6890	64.3297	65.4363	66.6291	67.4722	68.3537 (38)
Heat transfer coeff	165.5834	165.0995	164.6253	162.3977	161.9810	160.0408	160.0408	159.6815	160.7881	161.9810	162.8241	163.7055 (39)
Average = Sum(39)m / 12 =												162.3957 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1324	1.1291	1.1259	1.1106	1.1078	1.0945	1.0945	1.0921	1.0996	1.1078	1.1136	1.1196 (40)
HLP (average)												1.1106 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)										Total = Sum(45)m =		1632.2752 (45)
Distribution loss (46)m = 0.15 x (45)m												
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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.9618	31.4524	32.4561	28.2960	27.1507	23.4290	21.7104	24.9130	25.2105	29.3804	32.0711	34.8271 (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	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	146.4055	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.8632	25.6360	20.8486	15.7837	11.7985	9.9608	10.7630	13.9902	18.7776	23.8424	27.8276	29.6654	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.3799	319.6630	311.3898	293.7773	271.5446	250.6491	236.6896	233.4065	241.6797	259.2922	281.5249	302.4204	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	37.6405	(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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	(71)
Water heating gains (Table 5)	48.3358	46.8042	43.6238	39.3000	36.4929	32.5402	29.1806	33.4852	35.0146	39.4898	44.5431	46.8106	(72)
Total internal gains	460.5005	459.0248	442.7839	415.7827	386.7577	360.0718	343.5548	347.8035	362.3935	389.5461	420.8173	445.8180	(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	0.6900	10.6334	0.6300	0.7000	0.7700	2.2423 (74)
Northeast	10.2800	11.2829	0.6300	0.7000	0.7700	35.4476 (75)
Southeast	1.1300	36.7938	0.6300	0.7000	0.7700	12.7065 (77)
South	1.3000	46.7521	0.6300	0.7000	0.7700	18.5745 (78)
Southwest	8.2600	36.7938	0.6300	0.7000	0.7700	92.8810 (79)
West	1.9900	19.6403	0.6300	0.7000	0.7700	11.9446 (80)
Northwest	2.3600	11.2829	0.6300	0.7000	0.7700	8.1378 (81)

Solar gains	181.9343	326.6454	490.4411	679.0347	824.5637	846.4425	804.4969	691.8708	555.2187	372.8376	220.9880	153.6969	(83)
Total gains	642.4348	785.6703	933.2250	1094.8174	1211.3213	1206.5143	1148.0518	1039.6743	917.6122	762.3837	641.8052	599.5150	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.3236	61.5033	61.6805	62.5265	62.6874	63.4474	63.4474	63.5901	63.1525	62.6874	62.3628	62.0270	
alpha	5.0882	5.1002	5.1120	5.1684	5.1792	5.2298	5.2298	5.2393	5.2102	5.1792	5.1575	5.1351	
util living area	0.9995	0.9986	0.9950	0.9779	0.9144	0.7638	0.5940	0.6686	0.9071	0.9909	0.9989	0.9997	(86)
MIT	19.6320	19.7920	20.0591	20.4214	20.7419	20.9333	20.9856	20.9744	20.8204	20.3986	19.9511	19.6108	(87)
Th 2	19.9744	19.9771	19.9798	19.9922	19.9945	20.0053	20.0053	20.0073	20.0011	19.9945	19.9898	19.9849	(88)
util rest of house	0.9994	0.9981	0.9930	0.9686	0.8783	0.6763	0.4696	0.5426	0.8527	0.9859	0.9985	0.9996	(89)
MIT 2	18.7158	18.8778	19.1460	19.5129	19.8135	19.9734	20.0015	19.9996	19.8933	19.4960	19.0471	18.7029	(90)
Living area fraction									fLA = Living area / (4) =			0.1578	(91)
MIT	18.8603	19.0220	19.2901	19.6562	19.9599	20.1249	20.1568	20.1534	20.0395	19.6384	19.1897	18.8462	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8603	19.0220	19.2901	19.6562	19.9599	20.1249	20.1568	20.1534	20.0395	19.6384	19.1897	18.8462	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9991	0.9974	0.9912	0.9647	0.8768	0.6878	0.4894	0.5624	0.8552	0.9834	0.9979	0.9994	(94)
Ext temp.	641.8712	783.6380	925.0558	1056.1176	1062.0841	829.8758	561.8151	584.7092	784.7873	749.7119	640.4682	599.1505	(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	2410.9467	2331.5429	2105.5691	1746.7833	1337.9533	884.2036	569.2283	599.3443	955.0078	1464.0518	1968.4989	2397.6599	(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	1316.1921	1040.1921	878.3019	497.2793	205.2467	0.0000	0.0000	0.0000	0.0000	531.4688	956.1821	1338.0910	(98)
Space heating per m2												6762.9541	(98)
											(98) / (4) =	46.2519	(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	1504.3837	1184.3021	1213.5797	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8478	0.9140	0.8782	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1275.4229	1082.4066	1065.7094	0.0000	0.0000	0.0000	0.0000	(102)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1534.9528	1463.7362	1339.5677	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	186.8615	283.7092	203.7505	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												674.3212 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	46.7154	70.9273	50.9376	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												168.5803 (107)
Space cooling per m2												1.1529 (108)
Energy for space heating												46.2519 (99)
Energy for space cooling												1.1529 (108)
Total												47.4048 (109)
Target Fabric Energy Efficiency (TFEE)												54.5 (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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 350.1306 (5)
Dwelling volume			

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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					4.5300
Infiltration rate					0.3407 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3407 (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	0.3578	0.3322	0.3407	0.3237	0.3237	0.3152	0.3067	0.2982	0.2896	0.3152	0.2982	0.3152 (22b)
Effective ac	0.5640	0.5552	0.5581	0.5524	0.5524	0.5497	0.5470	0.5444	0.5419	0.5497	0.5444	0.5497 (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)			21.9100	1.3258	29.0473		(27)
French (Uw = 1.40)			4.1000	1.3258	5.4356		(27)
Jet Floor			73.5000	0.1500	11.0250	75.0000	5512.5000 (28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000 (29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800 (30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 92.7225		(33)
GF - Timber			51.6100			9.0000	464.4900 (32c)
GF - Metal			9.8400			20.0000	196.8000 (32c)
GF - Masonry			40.4700			39.0000	1578.3300 (32c)
1F - Timber			99.9900			9.0000	899.9100 (32c)
1F - Metal			51.2900			20.0000	1025.8000 (32c)
Internal Floor			72.7400			18.0000	1309.3200 (32d)
Internal Floor			72.7400			18.0000	1309.3200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21536.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							147.2861 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.8395 (36)
Total fabric heat loss							(33) + (36) = 104.5620 (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	65.1667	64.1480	64.4792	63.8252	63.8252	63.5108	63.2047	62.9071	62.6178	63.5108	62.9071	63.5108 (38)
Heat transfer coeff	169.7286	168.7099	169.0411	168.3871	168.3871	168.0727	167.7667	167.4690	167.1798	168.0727	167.4690	168.0727 (39)
Average = Sum(39)m / 12 =												168.1964 (39)
HLP	1.1608	1.1538	1.1561	1.1516	1.1516	1.1495	1.1474	1.1453	1.1433	1.1495	1.1453	1.1495 (40)
HLP (average)												1.1503 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												
	25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss												
	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage												
	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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												
	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (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)
												0.0000 (63)
Output from w/h												
	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	93.8962	83.1991	88.4108	80.6877	80.1094	73.0723	71.5969	76.6081	75.8599	83.5983	86.5946	92.1207 (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	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	72.1579	64.0900	52.1215	39.4593	29.4963	24.9020	26.9075	34.9754	46.9439	59.6061	69.5691	74.1634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	472.2089	477.1089	464.7610	438.4736	405.2905	374.1031	353.2680	348.3679	360.7159	387.0033	420.1864	451.3738 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968 (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)												
	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244 (71)
Water heating gains (Table 5)												
	126.2046	123.8081	118.8317	112.0663	107.6739	101.4892	96.2324	102.9678	105.3609	112.3633	120.2702	123.8182 (72)
Total internal gains												
	787.6303	782.0660	752.7731	707.0582	659.5197	617.5533	593.4669	603.3701	630.0797	676.0317	727.0847	766.4143 (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	0.6900	13.4839	0.7100	0.7000	0.7700	3.2045 (74)
Northeast	6.1800	14.6176	0.7100	0.7000	0.7700	31.1140 (75)
Southeast	1.1300	45.1778	0.7100	0.7000	0.7700	17.5830 (77)
South	1.3000	56.7559	0.7100	0.7000	0.7700	25.4123 (78)
Southwest	8.2600	45.1778	0.7100	0.7000	0.7700	128.5272 (79)
West	1.9900	25.1925	0.7100	0.7000	0.7700	17.2669 (80)
Northwest	2.3600	14.6176	0.7100	0.7000	0.7700	11.8817 (81)
Northeast	4.1000	14.6176	0.7100	0.7000	0.7700	20.6420 (75)

Solar gains	255.6315	392.0455	597.0483	836.8031	968.6984	1080.9591	1019.0747	896.3169	715.7734	483.8585	309.7942	212.1022 (83)
Total gains	1043.2618	1174.1115	1349.8214	1543.8613	1628.2181	1698.5124	1612.5416	1499.6871	1345.8531	1159.8902	1036.8789	978.5165 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	35.2461	35.4589	35.3894	35.5269	35.5269	35.5933	35.6583	35.7216	35.7835	35.5933	35.7216	35.5933
alpha	3.3497	3.3639	3.3593	3.3685	3.3685	3.3729	3.3772	3.3814	3.3856	3.3729	3.3814	3.3729
util living area												
	0.9751	0.9629	0.9287	0.8496	0.7191	0.5252	0.3941	0.4203	0.6700	0.8791	0.9565	0.9787 (86)
MIT	19.3729	19.5573	19.9430	20.4059	20.7524	20.9373	20.9821	20.9783	20.8556	20.4350	19.8551	19.3527 (87)
Th 2	19.9515	19.9571	19.9553	19.9589	19.9589	19.9607	19.9623	19.9640	19.9656	19.9607	19.9640	19.9607 (88)
util rest of house												
	0.9699	0.9554	0.9141	0.8190	0.6629	0.4423	0.2943	0.3152	0.5904	0.8464	0.9461	0.9743 (89)
MIT 2	17.8082	18.0767	18.6253	19.2671	19.7130	19.9159	19.9544	19.9543	19.8460	19.3238	18.5140	17.7853 (90)
Living area fraction												
	18.0551	18.3103	18.8332	19.4468	19.8770	20.0771	20.1166	20.1159	20.0053	19.4991	18.7256	18.0326 (92)
Temperature adjustment												
adjusted MIT	17.9051	18.1603	18.6832	19.2968	19.7270	19.9271	19.9666	19.9659	19.8553	19.3491	18.5756	17.8826 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9554	0.9376	0.8911	0.7959	0.6490	0.4395	0.2947	0.3154	0.5811	0.8225	0.9267	0.9612 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Useful gains	996.7836	1100.8060	1202.8757	1228.8231	1056.7458	746.4133	475.2155	472.9680	782.0106	954.0312	960.8749	940.5258	(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													
Month fracti	2207.3413	2169.6587	1974.9468	1649.6552	1216.9275	777.6817	480.9160	479.9417	861.8639	1336.0289	1787.8378	2165.2064	(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	900.6549	718.2691	574.4209	302.9991	119.1752	0.0000	0.0000	0.0000	0.0000	284.2063	595.4133	911.1623	(98)
RHI space heating demand												4406.3010	(98)
												4406	(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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.1306 (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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					4.5300
Infiltration rate					0.3407 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3407 (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	0.4344	0.4259	0.4174	0.3748	0.3663	0.3237	0.3237	0.3152	0.3407	0.3663	0.3833	0.4004 (22b)
Effective ac	0.5944	0.5907	0.5871	0.5702	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5801 (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)			21.9100	1.3258	29.0473		(27)
French (Uw = 1.40)			4.1000	1.3258	5.4356		(27)
Jet Floor			73.5000	0.1500	11.0250	75.0000	5512.5000 (28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000 (29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800 (30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.7225		(33)
GF - Timber			51.6100			9.0000	464.4900 (32c)
GF - Metal			9.8400			20.0000	196.8000 (32c)
GF - Masonry			40.4700			39.0000	1578.3300 (32c)
1F - Timber			99.9900			9.0000	899.9100 (32c)
1F - Metal			51.2900			20.0000	1025.8000 (32c)
Internal Floor			72.7400			18.0000	1309.3200 (32d)
Internal Floor			72.7400			18.0000	1309.3200 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		21536.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							147.2861 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.8395 (36)
Total fabric heat loss						(33) + (36) =	104.5620 (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	68.6756	68.2522	67.8372	65.8878	65.5230	63.8252	63.8252	63.5108	64.4792	65.5230	66.2609	67.0322 (38)
Heat transfer coeff	173.2376	172.8142	172.3991	170.4497	170.0850	168.3871	168.3871	168.0727	169.0411	170.0850	170.8228	171.5942 (39)
Average = Sum(39)m / 12 =												170.4480 (39)
HLP	1.1848	1.1819	1.1790	1.1657	1.1632	1.1516	1.1516	1.1495	1.1561	1.1632	1.1683	1.1735 (40)
HLP (average)												1.1657 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m	25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
Heat gains from water heating, kWh/month	93.8962	83.1991	88.4108	80.6877	80.1094	73.0723	71.5969	76.6081	75.8599	83.5983	86.5946	92.1207 (65)
Total per year (kWh/year) = Sum(64)m =												2186.0532 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	72.1579	64.0900	52.1215	39.4593	29.4963	24.9020	26.9075	34.9754	46.9439	59.6061	69.5691	74.1634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	472.2089	477.1089	464.7610	438.4736	405.2905	374.1031	353.2680	348.3679	360.7159	387.0033	420.1864	451.3738 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968 (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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244 (71)
Water heating gains (Table 5)	126.2046	123.8081	118.8317	112.0663	107.6739	101.4892	96.2324	102.9678	105.3609	112.3633	120.2702	123.8182 (72)
Total internal gains	787.6303	782.0660	752.7731	707.0582	659.5197	617.5533	593.4669	603.3701	630.0797	676.0317	727.0847	766.4143 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g or Table 6c	FF or Table 6c	Access factor Table 6d	Gains W
North	0.6900	10.6334	0.7100	0.7100	0.7000	0.7700	2.5270 (74)
Northeast	6.1800	11.2829	0.7100	0.7100	0.7000	0.7700	24.0160 (75)
Southeast	1.1300	36.7938	0.7100	0.7100	0.7000	0.7700	14.3200 (77)
South	1.3000	46.7521	0.7100	0.7100	0.7000	0.7700	20.9331 (78)
Southwest	8.2600	36.7938	0.7100	0.7100	0.7000	0.7700	104.6754 (79)
West	1.9900	19.6403	0.7100	0.7100	0.7000	0.7700	13.4614 (80)
Northwest	2.3600	11.2829	0.7100	0.7100	0.7000	0.7700	9.1712 (81)
Northeast	4.1000	11.2829	0.7100	0.7100	0.7000	0.7700	15.9329 (75)

Solar gains	205.0370	368.1242	552.7194	765.2613	929.2702	953.9273	906.6553	779.7274	625.7227	420.1820	249.0499	173.2140 (83)
Total gains	992.6673	1150.1903	1305.4925	1472.3195	1588.7899	1571.4806	1500.1222	1383.0976	1255.8024	1096.2137	976.1346	939.6283 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.5322	34.6168	34.7001	35.0970	35.1722	35.5269	35.5269	35.5933	35.3894	35.1722	35.0203	34.8629
alpha	3.3021	3.3078	3.3133	3.3398	3.3448	3.3685	3.3685	3.3729	3.3593	3.3448	3.3347	3.3242
util living area	0.9806	0.9677	0.9409	0.8792	0.7681	0.6109	0.4696	0.5214	0.7414	0.9123	0.9690	0.9836 (86)
MIT	19.1909	19.4256	19.7999	20.2725	20.6575	20.8881	20.9653	20.9505	20.7765	20.2712	19.6477	19.1487 (87)
Th 2	19.9322	19.9345	19.9368	19.9475	19.9495	19.9589	19.9589	19.9607	19.9553	19.9495	19.9455	19.9412 (88)
util rest of house	0.9767	0.9612	0.9287	0.8539	0.7199	0.5328	0.3681	0.4178	0.6720	0.8883	0.9616	0.9803 (89)
MIT 2	17.5324	17.8727	18.4105	19.0792	19.5895	19.8683	19.9403	19.9319	19.7523	19.0937	18.2046	17.4769 (90)
Living area fraction										fLA = Living area / (4) =		0.1578 (91)
MIT	17.7941	18.1177	18.6297	19.2675	19.7580	20.0292	20.1020	20.0926	19.9139	19.2795	18.4323	17.7407 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6441	17.9677	18.4797	19.1175	19.6080	19.8792	19.9520	19.9426	19.7639	19.1295	18.2823	17.5907 (93)

8. Space heating requirement

Utilisation	0.9641	0.9443	0.9066	0.8295	0.7021	0.5264	0.3674	0.4158	0.6574	0.8640	0.9449	0.9691 (94)
Useful gains	956.9883	1086.1024	1183.5708	1221.3198	1115.4922	827.1680	551.1682	575.1469	825.5681	947.1670	922.3266	910.5992 (95)

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Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	2311.6939	2258.2837	2065.2972	1741.5662	1345.0302	888.9496	564.4354	595.4122	957.4289	1450.7410	1910.1879	2297.7605 (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	1007.9010	787.7058	656.0045	374.5774	170.7763	0.0000	0.0000	0.0000	0.0000	374.6591	711.2602	1032.0480 (98)
Space heating												5114.9322 (98)
Space heating per m2											(98) / (4) =	34.9811 (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												5670.6565 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1007.9010	787.7058	656.0045	374.5774	170.7763	0.0000	0.0000	0.0000	0.0000	374.6591	711.2602	1032.0480 (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)	1117.4068	873.2881	727.2777	415.2743	189.3307	0.0000	0.0000	0.0000	0.0000	415.3648	788.5368	1144.1774 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
Efficiency of water heater (217)m	88.1051	87.8962	87.4524	86.4426	84.4507	79.5000	79.5000	79.5000	79.5000	86.3540	87.6471	79.5000 (216)
Fuel for water heating, kWh/month	245.4628	216.7249	228.4303	206.6962	206.9861	195.9371	187.6726	206.6299	206.4828	214.5750	224.1246	239.1827 (219)
Water heating fuel used												2578.9050 (219)
Annual totals kWh/year												
Space heating fuel - main system												5670.6565 (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)												509.7324 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.08 * 1004 * 1.00) =									-867.4527			-867.4527 (233)
Total delivered energy for all uses												7966.8412 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5670.6565	3.4800	197.3388 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2578.9050	3.4800	89.7459 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	509.7324	13.1900	67.2337 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-867.4527	13.1900	-114.4170 (252)
Total energy cost			369.7939 (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] =	0.8122 (257)
SAP value		88.6695
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	5670.6565	0.2160	1224.8618 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2578.9050	0.2160	557.0435 (264)
Space and water heating			1781.9053 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	509.7324	0.5190	264.5511 (268)

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Energy saving/generation technologies			
PV Unit	-867.4527	0.5190	-450.2080 (269)
Total kg/year			1635.1735 (272)
CO2 emissions per m2			11.1800 (273)
EI value			88.5413
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	$3.48 / 0.8454 = 4.116$, stars = 4
Water heating environmental impact	$0.216 / 0.8454 = 0.2555$, stars = 4

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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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 350.1306 (5)
Dwelling volume			

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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					4.5300
Infiltration rate					0.3407 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3407 (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	0.3578	0.3322	0.3407	0.3237	0.3237	0.3152	0.3067	0.2982	0.2896	0.3152	0.2982	0.3152 (22b)
Effective ac	0.5640	0.5552	0.5581	0.5524	0.5524	0.5497	0.5470	0.5444	0.5419	0.5497	0.5444	0.5497 (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)			21.9100	1.3258	29.0473		(27)
French (Uw = 1.40)			4.1000	1.3258	5.4356		(27)
Jet Floor			73.5000	0.1500	11.0250	75.0000	5512.5000 (28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000 (29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800 (30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 92.7225		(33)
GF - Timber			51.6100			9.0000	464.4900 (32c)
GF - Metal			9.8400			20.0000	196.8000 (32c)
GF - Masonry			40.4700			39.0000	1578.3300 (32c)
1F - Timber			99.9900			9.0000	899.9100 (32c)
1F - Metal			51.2900			20.0000	1025.8000 (32c)
Internal Floor			72.7400			18.0000	1309.3200 (32d)
Internal Floor			72.7400			18.0000	1309.3200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21536.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							147.2861 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.8395 (36)
Total fabric heat loss							(33) + (36) = 104.5620 (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	65.1667	64.1480	64.4792	63.8252	63.8252	63.5108	63.2047	62.9071	62.6178	63.5108	62.9071	63.5108 (38)
Heat transfer coeff	169.7286	168.7099	169.0411	168.3871	168.3871	168.0727	167.7667	167.4690	167.1798	168.0727	167.4690	168.0727 (39)
Average = Sum(39)m / 12 =												168.1964 (39)
HLP	1.1608	1.1538	1.1561	1.1516	1.1516	1.1495	1.1474	1.1453	1.1433	1.1495	1.1453	1.1495 (40)
HLP (average)												1.1503 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m	25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
Heat gains from water heating, kWh/month	93.8962	83.1991	88.4108	80.6877	80.1094	73.0723	71.5969	76.6081	75.8599	83.5983	86.5946	92.1207 (65)
Total per year (kWh/year) = Sum(64)m =												2186.0532 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	72.1579	64.0900	52.1215	39.4593	29.4963	24.9020	26.9075	34.9754	46.9439	59.6061	69.5691	74.1634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	472.2089	477.1089	464.7610	438.4736	405.2905	374.1031	353.2680	348.3679	360.7159	387.0033	420.1864	451.3738 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968 (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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244 (71)
Water heating gains (Table 5)	126.2046	123.8081	118.8317	112.0663	107.6739	101.4892	96.2324	102.9678	105.3609	112.3633	120.2702	123.8182 (72)
Total internal gains	787.6303	782.0660	752.7731	707.0582	659.5197	617.5533	593.4669	603.3701	630.0797	676.0317	727.0847	766.4143 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.6900	13.4839	0.7100	0.7000	0.7700	3.2045 (74)
Northeast	6.1800	14.6176	0.7100	0.7000	0.7700	31.1140 (75)
Southeast	1.1300	45.1778	0.7100	0.7000	0.7700	17.5830 (77)
South	1.3000	56.7559	0.7100	0.7000	0.7700	25.4123 (78)
Southwest	8.2600	45.1778	0.7100	0.7000	0.7700	128.5272 (79)
West	1.9900	25.1925	0.7100	0.7000	0.7700	17.2669 (80)
Northwest	2.3600	14.6176	0.7100	0.7000	0.7700	11.8817 (81)
Northeast	4.1000	14.6176	0.7100	0.7000	0.7700	20.6420 (75)

Solar gains	255.6315	392.0455	597.0483	836.8031	968.6984	1080.9591	1019.0747	896.3169	715.7734	483.8585	309.7942	212.1022 (83)
Total gains	1043.2618	1174.1115	1349.8214	1543.8613	1628.2181	1698.5124	1612.5416	1499.6871	1345.8531	1159.8902	1036.8789	978.5165 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	35.2461	35.4589	35.3894	35.5269	35.5269	35.5933	35.6583	35.7216	35.7835	35.5933	35.7216	35.5933
alpha	3.3497	3.3639	3.3593	3.3685	3.3685	3.3729	3.3772	3.3814	3.3856	3.3729	3.3814	3.3729
util living area	0.9751	0.9629	0.9287	0.8496	0.7191	0.5252	0.3941	0.4203	0.6700	0.8791	0.9565	0.9787 (86)
MIT	19.3729	19.5573	19.9430	20.4059	20.7524	20.9373	20.9821	20.9783	20.8556	20.4350	19.8551	19.3527 (87)
Th 2	19.9515	19.9571	19.9553	19.9589	19.9589	19.9607	19.9623	19.9640	19.9656	19.9607	19.9640	19.9607 (88)
util rest of house	0.9699	0.9554	0.9141	0.8190	0.6629	0.4423	0.2943	0.3152	0.5904	0.8464	0.9461	0.9743 (89)
MIT 2	17.8082	18.0767	18.6253	19.2671	19.7130	19.9159	19.9544	19.9543	19.8460	19.3238	18.5140	17.7853 (90)
Living area fraction									fLA = Living area / (4) =			0.1578 (91)
MIT	18.0551	18.3103	18.8332	19.4468	19.8770	20.0771	20.1166	20.1159	20.0053	19.4991	18.7256	18.0326 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9051	18.1603	18.6832	19.2968	19.7270	19.9271	19.9666	19.9659	19.8553	19.3491	18.5756	17.8826 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9554	0.9376	0.8911	0.7959	0.6490	0.4395	0.2947	0.3154	0.5811	0.8225	0.9267	0.9612 (94)
	996.7836	1100.8060	1202.8757	1228.8231	1056.7458	746.4133	475.2155	472.9680	782.0106	954.0312	960.8749	940.5258 (95)

FULL SAP CALCULATION PRINTOUT

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

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	2207.3413	2169.6587	1974.9468	1649.6552	1216.9275	777.6817	480.9160	479.9417	861.8639	1336.0289	1787.8378	2165.2064 (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	900.6549	718.2691	574.4209	302.9991	119.1752	0.0000	0.0000	0.0000	0.0000	284.2063	595.4133	911.1623 (98)
Space heating												4406.3010 (98)
Space heating per m2											(98) / (4) =	30.1347 (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												4885.0344 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	900.6549	718.2691	574.4209	302.9991	119.1752	0.0000	0.0000	0.0000	0.0000	284.2063	595.4133	911.1623 (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)	998.5088	796.3072	636.8302	335.9192	132.1233	0.0000	0.0000	0.0000	0.0000	315.0845	660.1034	1010.1578 (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	216.2652	190.4930	199.7677	178.6736	174.8011	155.7700	149.1997	164.2708	164.1538	185.2941	196.4386	210.9254 (64)
Efficiency of water heater	87.9091	87.7250	87.1726	85.9108	83.5163	79.5000	79.5000	79.5000	79.5000	85.6504	87.2856	79.5000 (216)
(217)m	87.9091	87.7250	87.1726	85.9108	83.5163	79.5000	79.5000	79.5000	79.5000	85.6504	87.2856	87.9743 (217)
Fuel for water heating, kWh/month	246.0102	217.1478	229.1635	207.9757	209.3019	195.9371	187.6726	206.6299	206.4828	216.3377	225.0526	239.7581 (219)
Water heating fuel used												2587.4699 (219)
Annual totals kWh/year												
Space heating fuel - main system												4885.0344 (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)												509.7324 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.08 * 1122 * 1.00) =									-969.3394			-969.3394 (233)
Total delivered energy for all uses												7087.8973 (238)

10a. Fuel costs - using BEDF prices (451)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4885.0344	3.9300	191.9819 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2587.4699	3.9300	101.6876 (247)
Pumps and fans for heating	75.0000	17.5600	13.1700 (249)
Energy for lighting	509.7324	17.5600	89.5090 (250)
Additional standing charges			88.0000 (251)
Energy saving/generation technologies			
PV Unit	-969.3394	17.5600	-170.2160 (252)
Total energy cost			314.1324 (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	4885.0344	0.2160	1055.1674 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2587.4699	0.2160	558.8935 (264)
Space and water heating			1614.0609 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	509.7324	0.5190	264.5511 (268)
Energy saving/generation technologies			
PV Unit	-969.3394	0.5190	-503.0872 (269)
Total kg/year			1414.4499 (272)

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

Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
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Space heating - main system 1	4885.0344	1.2200	5959.7419 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2587.4699	1.2200	3156.7133 (264)
Space and water heating			9116.4552 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	509.7324	3.0700	1564.8786 (268)
Energy saving/generation technologies			
PV Unit	-969.3394	3.0700	-2975.8720 (269)
Primary energy kWh/year			7935.7118 (272)
Primary energy kWh/m2/year			54.2724 (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	+ 1.2	-£ 45	-269 kg (19.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£45	1.84 kg/m²	B 90
Total Savings	£45	1.84 kg/m²	B 90

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

Fuel prices for cost data on this page from database revision number 451 TEST (05 Nov 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	£103	£111	-£9
Mains gas	£382	£328	£54
Space heating	£293	£295	-£1
Water heating	£102	£55	£46
Lighting	£90	£90	£0
Generated (PV)	-£170	-£170	£0
Total cost of fuels	£315	£269	£45
Total cost of uses	£315	£270	£45
Delivered energy	48 kWh/m²	39 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.4 tonnes	1.1 tonnes	0.3 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	54 kWh/m²	44 kWh/m²	10 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



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

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	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.1306 (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) = 0.1142 (8)
Pressure test					Yes
Measured/design AP50					4.5300
Infiltration rate					0.3407 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3407 (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	0.4344	0.4259	0.4174	0.3748	0.3663	0.3237	0.3237	0.3152	0.3407	0.3663	0.3833	0.4004 (22b)
Effective ac	0.5944	0.5907	0.5871	0.5702	0.5671	0.5524	0.5524	0.5497	0.5581	0.5671	0.5735	0.5801 (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)			21.9100	1.3258	29.0473		(27)
French (Uw = 1.40)			4.1000	1.3258	5.4356		(27)
Jet Floor			73.5000	0.1500	11.0250	75.0000	5512.5000 (28a)
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000 (29a)
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800 (30)
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			318.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	92.7225	(33)
GF - Timber			51.6100			9.0000	464.4900 (32c)
GF - Metal			9.8400			20.0000	196.8000 (32c)
GF - Masonry			40.4700			39.0000	1578.3300 (32c)
1F - Timber			99.9900			9.0000	899.9100 (32c)
1F - Metal			51.2900			20.0000	1025.8000 (32c)
Internal Floor			72.7400			18.0000	1309.3200 (32d)
Internal Floor			72.7400			18.0000	1309.3200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21536.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							147.2861 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.8395 (36)
Total fabric heat loss							(33) + (36) = 104.5620 (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	68.6756	68.2522	67.8372	65.8878	65.5230	63.8252	63.8252	63.5108	64.4792	65.5230	66.2609	67.0322 (38)
Heat transfer coeff	173.2376	172.8142	172.3991	170.4497	170.0850	168.3871	168.3871	168.0727	169.0411	170.0850	170.8228	171.5942 (39)
Average = Sum(39)m / 12 =												170.4480 (39)
HLP	1.1848	1.1819	1.1790	1.1657	1.1632	1.1516	1.1516	1.1495	1.1561	1.1632	1.1683	1.1735 (40)
HLP (average)												1.1657 (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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)										Total = Sum(45)m =		1632.2752 (45)
Distribution loss (46)m = 0.15 x (45)m												
25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)	
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss												
23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)	
If cylinder contains dedicated solar storage												
15.2812	13.8024	15.2812	14.7883	15.2812	14.7883	15.2812	15.2812	14.7883	15.2812	14.7883	15.2812 (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												
207.7756	182.8250	189.8824	163.7043	153.5172	134.9476	127.6832	143.6848	150.5352	175.4088	188.2229	202.4358 (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												1.1111 (H8)
Utilisation factor												0.5934 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												103.7426 (H14)
Volume ratio Veff/V												1.1133 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-946.3482 (H17)
Solar input	-27.4422	-45.7932	-77.9910	-104.5233	-129.1297	-126.9551	-125.2773	-109.4554	-85.7256	-58.5405	-32.5504	-22.9644 (63)
								Solar input (sum of months) = Sum(63)m =				-946.3482 (63)
Output from w/h												
180.3334	137.0318	111.8914	59.1810	24.3875	7.9925	2.4059		34.2293	64.8096	116.8683	155.6725	179.4714 (64)
								Total per year (kWh/year) = Sum(64)m =				1074.2747 (64)
Heat gains from water heating, kWh/month												
87.1045	77.0647	80.5025	68.7123	63.0823	56.4143	54.3837	60.1392	64.9650	75.6901	80.0220	85.3291 (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	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	72.1579	64.0900	52.1215	39.4593	29.4963	24.9020	26.9075	34.9754	46.9439	59.6061	69.5691	74.1634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	472.2089	477.1089	464.7610	438.4736	405.2905	374.1031	353.2680	348.3679	360.7159	387.0033	420.1864	451.3738 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968 (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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244 (71)
Water heating gains (Table 5)	117.0760	114.6796	108.2023	95.4337	84.7880	78.3532	73.0964	80.8323	90.2292	101.7340	111.1417	114.6896 (72)
Total internal gains	778.5017	772.9375	742.1437	690.4256	636.6338	594.4173	570.3309	581.2346	614.9480	665.4023	717.9561	757.2857 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF	Access factor Table 6d	Gains W
North	0.6900	10.6334	0.7100	0.7100	0.7000	0.7700	2.5270 (74)
Northeast	6.1800	11.2829	0.7100	0.7100	0.7000	0.7700	24.0160 (75)
Southeast	1.1300	36.7938	0.7100	0.7100	0.7000	0.7700	14.3200 (77)
South	1.3000	46.7521	0.7100	0.7100	0.7000	0.7700	20.9331 (78)
Southwest	8.2600	36.7938	0.7100	0.7100	0.7000	0.7700	104.6754 (79)
West	1.9900	19.6403	0.7100	0.7100	0.7000	0.7700	13.4614 (80)
Northwest	2.3600	11.2829	0.7100	0.7100	0.7000	0.7700	9.1712 (81)
Northeast	4.1000	11.2829	0.7100	0.7100	0.7000	0.7700	15.9329 (75)

Solar gains	205.0370	368.1242	552.7194	765.2613	929.2702	953.9273	906.6553	779.7274	625.7227	420.1820	249.0499	173.2140 (83)
Total gains	983.5388	1141.0617	1294.8631	1455.6869	1565.9040	1548.3446	1476.9862	1360.9621	1240.6706	1085.5843	967.0060	930.4997 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	34.5322	34.6168	34.7001	35.0970	35.1722	35.5269	35.5269	35.5933	35.3894	35.1722	35.0203	34.8629
alpha	3.3021	3.3078	3.3133	3.3398	3.3448	3.3685	3.3685	3.3729	3.3593	3.3448	3.3347	3.3242
util living area	0.9811	0.9684	0.9421	0.8821	0.7737	0.6175	0.4759	0.5283	0.7463	0.9143	0.9697	0.9841 (86)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	19.1829	19.4180	19.7919	20.2627	20.6491	20.8843	20.9639	20.9485	20.7716	20.2641	19.6400	19.1406 (87)
Th 2	19.9322	19.9345	19.9368	19.9475	19.9495	19.9589	19.9589	19.9607	19.9553	19.9495	19.9455	19.9412 (88)
util rest of house												
	0.9772	0.9620	0.9301	0.8572	0.7259	0.5392	0.3735	0.4239	0.6772	0.8907	0.9625	0.9808 (89)
MIT 2	17.5209	17.8618	18.3994	19.0662	19.5797	19.8650	19.9395	19.9306	19.7473	19.0842	18.1937	17.4652 (90)
Living area fraction									fLA = Living area / (4) =			0.1578 (91)
MIT	17.7831	18.1074	18.6191	19.2550	19.7484	20.0258	20.1011	20.0912	19.9089	19.2704	18.4219	17.7295 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6331	17.9574	18.4691	19.1050	19.5984	19.8758	19.9511	19.9412	19.7589	19.1204	18.2719	17.5795 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9649	0.9453	0.9082	0.8328	0.7077	0.5325	0.3727	0.4218	0.6623	0.8665	0.9461	0.9698	(94)
Useful gains	948.9733	1078.6232	1175.9366	1212.3191	1108.2499	824.4484	550.4317	574.0319	821.7385	940.6276	914.8369	902.4447	(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	2309.7979	2256.4984	2063.4622	1739.4426	1343.4049	888.3774	564.2791	595.1762	956.5817	1449.1847	1908.4144	2295.8513	(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	1012.4535	791.5322	660.3190	379.5289	174.9553	0.0000	0.0000	0.0000	0.0000	378.3665	715.3758	1036.6945	(98)
Space heating												5149.2257	(98)
Space heating per m2												35.2156	(99)
												(98) / (4) =	

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													5708.6760 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1012.4535	791.5322	660.3190	379.5289	174.9553	0.0000	0.0000	0.0000	0.0000	378.3665	715.3758	1036.6945	(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)	1122.4540	877.5301	732.0610	420.7638	193.9638	0.0000	0.0000	0.0000	0.0000	419.4750	793.0996	1149.3287	(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	180.3334	137.0318	111.8914	59.1810	24.3875	7.9925	2.4059	34.2293	64.8096	116.8683	155.6725	179.4714	(64)
Efficiency of water heater (217)m	88.4012	88.4433	88.4746	88.5915	88.7388	79.5000	79.5000	79.5000	79.5000	87.4233	88.0813	88.4434	(216)
Fuel for water heating, kWh/month	203.9944	154.9375	126.4673	66.8021	27.4823	10.0534	3.0263	43.0558	81.5216	133.6810	176.7373	202.9224	(219)
Water heating fuel used												1230.6812	(219)
Annual totals kWh/year													
Space heating fuel - main system												5708.6760	(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)												509.7324	(232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 1.08 * 1004 * 1.00) =									-867.4527			-867.4527	(233)
Total delivered energy for all uses												6706.6369	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5708.6760	3.4800	198.6619	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1230.6812	3.4800	42.8277	(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	509.7324	13.1900	67.2337	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-867.4527	13.1900	-114.4170	(252)
Total energy cost			330.7938	(255)

11a. SAP rating - Individual heating systems

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.7266 (257)
SAP value 89.8644
SAP rating (Section 12) 90 (258)
SAP band B

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

Energy Emission factor Emissions
kWh/year kg CO2/kWh kg CO2/year
Space heating - main system 1 5708.6760 0.2160 1233.0740 (261)
Space heating - secondary 0.0000 0.0000 0.0000 (263)
Water heating (other fuel) 1230.6812 0.2160 265.8271 (264)
Space and water heating 1498.9011 (265)
Pumps and fans 125.0000 0.5190 64.8750 (267)
Energy for lighting 509.7324 0.5190 264.5511 (268)

Energy saving/generation technologies
PV Unit -867.4527 0.5190 -450.2080 (269)
Total kg/year 1378.1193 (272)
CO2 emissions per m2 9.4200 (273)
EI value 90.3426
EI rating 90 (274)
EI band B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.5000 (1b)	x 2.3100 (2b)	= 169.7850 (1b) - (3b)
First floor	72.7200 (1c)	x 2.4800 (2c)	= 180.3456 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.2200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 350.1306 (5)
Dwelling volume			

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																4 * 10 =	40.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =										40.0000 / (5) =							0.1142 (8)
Pressure test										Yes							
Measured/design AP50																	4.5300
Infiltration rate																	0.3407 (18)
Number of sides sheltered																	0 (19)
Shelter factor										(20) = 1 - [0.075 x (19)] =							1.0000 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.3407 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	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)				
Adj infilt rate	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)				
	0.3578	0.3322	0.3407	0.3237	0.3237	0.3152	0.3067	0.2982	0.2896	0.3152	0.2982	0.3152	(22b)				
Effective ac	0.5640	0.5552	0.5581	0.5524	0.5524	0.5497	0.5470	0.5444	0.5419	0.5497	0.5444	0.5497	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Solid Door			2.1300	0.9000	1.9170			(26)					
Window (Uw = 1.40)			21.9100	1.3258	29.0473			(27)					
French (Uw = 1.40)			4.1000	1.3258	5.4356			(27)					
Jet Floor			73.5000	0.1500	11.0250		5512.5000	(28a)					
100mm Knauf Supafil	171.1100	28.1400	142.9700	0.2500	35.7425	60.0000	8578.2000	(29a)					
External Plane Ceiling	71.7200		71.7200	0.1300	9.3236	9.0000	645.4800	(30)					
Bay - Plane Ceiling	1.7800		1.7800	0.1300	0.2314	9.0000	16.0200	(30)					
Total net area of external elements Aum(A, m2)			318.1100					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.7225			(33)					
GF - Timber			51.6100			9.0000	464.4900	(32c)					
GF - Metal			9.8400			20.0000	196.8000	(32c)					
GF - Masonry			40.4700			39.0000	1578.3300	(32c)					
1F - Timber			99.9900			9.0000	899.9100	(32c)					
1F - Metal			51.2900			20.0000	1025.8000	(32c)					
Internal Floor			72.7400			18.0000	1309.3200	(32d)					
Internal Floor			72.7400			18.0000	1309.3200	(32e)					
Heat capacity Cm = Sum(A x k)								(28)...(30) + (32) + (32a)...(32e) = 21536.1700 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								147.2861 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								11.8395 (36)					
Total fabric heat loss						(33) + (36) =	104.5620	(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	65.1667	64.1480	64.4792	63.8252	63.8252	63.5108	63.2047	62.9071	62.6178	63.5108	62.9071	63.5108	(38)
Heat transfer coeff	169.7286	168.7099	169.0411	168.3871	168.3871	168.0727	167.7667	167.4690	167.1798	168.0727	167.4690	168.0727	(39)
Average = Sum(39)m / 12 =												168.1964	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1608	1.1538	1.1561	1.1516	1.1516	1.1495	1.1474	1.1453	1.1433	1.1495	1.1453	1.1495	(40)
HLP (average)												1.1503	(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												2.9281 (42)
Average daily hot water use (litres/day)												103.7426 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Daily hot water use	114.1169	109.9672	105.8175	101.6678	97.5181	93.3683	93.3683	97.5181	101.6678	105.8175	109.9672	114.1169 (44)
Energy conte	169.2320	148.0114	152.7345	133.1576	127.7679	110.2540	102.1665	117.2376	118.6378	138.2609	150.9226	163.8922 (45)
Energy content (annual)										Total = Sum(45)m =		1632.2752 (45)
Distribution loss (46)m = 0.15 x (45)m												
25.3848	22.2017	22.9102	19.9736	19.1652	16.5381	15.3250	17.5856	17.7957	20.7391	22.6384	24.5838 (46)	
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss												
23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)	
If cylinder contains dedicated solar storage												
15.2812	13.8024	15.2812	14.7883	15.2812	14.7883	15.2812	15.2812	14.7883	15.2812	14.7883	15.2812 (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												
207.7756	182.8250	189.8824	163.7043	153.5172	134.9476	127.6832	143.6848	150.5352	175.4088	188.2229	202.4358 (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												1.2435 (H8)
Utilisation factor												0.5526 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												103.7426 (H14)
Volume ratio Veff/V												1.1133 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-986.1398 (H17)
Solar input	-32.1703	-45.7441	-78.6231	-106.0807	-124.5982	-133.0905	-130.2916	-116.6149	-91.3015	-63.1227	-38.0489	-26.4533 (63)
Solar input (sum of months) = Sum(63)m =												-986.1398 (63)
Output from w/h												
175.6054	137.0809	111.2593	57.6236	28.9191	1.8570	0.0000		27.0698	59.2338	112.2861	150.1739	175.9825 (64)
Total per year (kWh/year) = Sum(64)m =												1037.0915 (64)
Heat gains from water heating, kWh/month												
87.1045	77.0647	80.5025	68.7123	63.0823	56.4143	54.3837	60.1392	64.9650	75.6901	80.0220	85.3291 (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	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866	175.6866 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	72.1579	64.0900	52.1215	39.4593	29.4963	24.9020	26.9075	34.9754	46.9439	59.6061	69.5691	74.1634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	472.2089	477.1089	464.7610	438.4736	405.2905	374.1031	353.2680	348.3679	360.7159	387.0033	420.1864	451.3738 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968	55.4968 (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)	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244	-117.1244 (71)
Water heating gains (Table 5)	117.0760	114.6796	108.2023	95.4337	84.7880	78.3532	73.0964	80.8323	90.2292	101.7340	111.1417	114.6896 (72)
Total internal gains	778.5017	772.9375	742.1437	690.4256	636.6338	594.4173	570.3309	581.2346	614.9480	665.4023	717.9561	757.2857 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF	Access factor Table 6d	Gains W
North	0.6900	13.4839	0.7100	0.7100	0.7000	0.7700	3.2045 (74)
Northeast	6.1800	14.6176	0.7100	0.7100	0.7000	0.7700	31.1140 (75)
Southeast	1.1300	45.1778	0.7100	0.7100	0.7000	0.7700	17.5830 (77)
South	1.3000	56.7559	0.7100	0.7100	0.7000	0.7700	25.4123 (78)
Southwest	8.2600	45.1778	0.7100	0.7100	0.7000	0.7700	128.5272 (79)
West	1.9900	25.1925	0.7100	0.7100	0.7000	0.7700	17.2669 (80)
Northwest	2.3600	14.6176	0.7100	0.7100	0.7000	0.7700	11.8817 (81)
Northeast	4.1000	14.6176	0.7100	0.7100	0.7000	0.7700	20.6420 (75)

Solar gains	255.6315	392.0455	597.0483	836.8031	968.6984	1080.9591	1019.0747	896.3169	715.7734	483.8585	309.7942	212.1022 (83)
Total gains	1034.1333	1164.9829	1339.1921	1527.2287	1605.3322	1675.3764	1589.4055	1477.5516	1330.7213	1149.2608	1027.7503	969.3879 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	35.2461	35.4589	35.3894	35.5269	35.5269	35.5933	35.6583	35.7216	35.7835	35.5933	35.7216	35.5933
alpha	3.3497	3.3639	3.3593	3.3685	3.3685	3.3729	3.3772	3.3814	3.3856	3.3729	3.3814	3.3729
util living area												
	0.9757	0.9636	0.9300	0.8529	0.7250	0.5311	0.3993	0.4260	0.6749	0.8815	0.9575	0.9793 (86)

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MIT	19.3651	19.5498	19.9353	20.3972	20.7457	20.9351	20.9813	20.9774	20.8522	20.4288	19.8478	19.3447 (87)
Th 2	19.9515	19.9571	19.9553	19.9589	19.9589	19.9607	19.9623	19.9640	19.9656	19.9607	19.9640	19.9607 (88)
util rest of house												
	0.9707	0.9563	0.9157	0.8227	0.6691	0.4477	0.2984	0.3197	0.5955	0.8493	0.9473	0.9749 (89)
MIT 2	17.7970	18.0660	18.6148	19.2560	19.7057	19.9142	19.9541	19.9539	19.8429	19.3158	18.5037	17.7738 (90)
Living area fraction									fLA = Living area / (4) =			0.1578 (91)
MIT	18.0444	18.3001	18.8231	19.4360	19.8698	20.0753	20.1162	20.1153	20.0021	19.4914	18.7158	18.0216 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8944	18.1501	18.6731	19.2860	19.7198	19.9253	19.9662	19.9653	19.8521	19.3414	18.5658	17.8716 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9564	0.9387	0.8928	0.7995	0.6548	0.4447	0.2988	0.3198	0.5858	0.8253	0.9281	0.9621 (94)	
Useful gains	989.0169	1093.5166	1195.6741	1220.9696	1051.2087	744.9987	474.9004	472.5770	779.5228	948.4613	953.8627	932.6054 (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													
	2205.5205	2167.9439	1973.2401	1647.8400	1215.7208	777.3889	480.8476	479.8569	861.3321	1334.7273	1786.1909	2163.3684 (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													
	905.0787	722.0152	578.5091	307.3467	122.3970	0.0000	0.0000	0.0000	0.0000	287.3818	599.2763	915.6877 (98)	
Space heating												4437.6925 (98)	
Space heating per m2											(98) / (4) =	30.3494 (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													4919.8364 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	905.0787	722.0152	578.5091	307.3467	122.3970	0.0000	0.0000	0.0000	0.0000	287.3818	599.2763	915.6877 (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)	1003.4132	800.4603	641.3626	340.7391	135.6952	0.0000	0.0000	0.0000	0.0000	318.6052	664.3862	1015.1748 (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	175.6054	137.0809	111.2593	57.6236	28.9191	1.8570	0.0000	27.0698	59.2338	112.2861	150.1739	175.9825 (64)	
Efficiency of water heater (217)m	88.2695	88.3036	88.2834	88.3231	87.9380	79.5000	79.5000	79.5000	79.5000	86.9135	87.8313	88.2845 (217)	
Fuel for water heating, kWh/month	198.9423	155.2382	126.0252	65.2418	32.8857	2.3359	0.0000	34.0501	74.5079	129.1929	170.9801	199.3356 (219)	
Water heating fuel used												1188.7357 (219)	
Annual totals kWh/year													
Space heating fuel - main system												4919.8364 (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)													509.7324 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 1.08 * 1122 * 1.00) =									-969.3394				-969.3394 (233)
Total delivered energy for all uses													5773.9651 (238)

10a. Fuel costs - using BEDF prices (451)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4919.8364	3.9300	193.3496 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1188.7357	3.9300	46.7173 (247)	
Pumps and fans for heating	75.0000	17.5600	13.1700 (249)	
Pump for solar water heating	50.0000	17.5600	8.7800 (249)	
Energy for lighting	509.7324	17.5600	89.5090 (250)	
Additional standing charges			88.0000 (251)	
Energy saving/generation technologies				
PV Unit	-969.3394	17.5600	-170.2160 (252)	
Total energy cost			269.3099 (255)	

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4919.8364	0.2160	1062.6847 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1188.7357	0.2160	256.7669 (264)
Space and water heating			1319.4516 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	509.7324	0.5190	264.5511 (268)
Energy saving/generation technologies			
PV Unit	-969.3394	0.5190	-503.0872 (269)
Total kg/year			1145.7906 (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	4919.8364	1.2200	6002.2004 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1188.7357	1.2200	1450.2576 (264)
Space and water heating			7452.4580 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	509.7324	3.0700	1564.8786 (268)
Energy saving/generation technologies			
PV Unit	-969.3394	3.0700	-2975.8720 (269)
Primary energy kWh/year			6425.2146 (272)
Primary energy kWh/m2/year			43.9421 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	147.3 (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	462.17 (P1)
Transmission heat loss coefficient	104.56 (37)
Summer heat loss coefficient	566.73 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North	1.000	0.90	1.000	0.900 (P8)
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
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	0.6900	87.1704	0.7100	0.7000	0.9000	24.2136
North East	6.1800	106.0502	0.7100	0.7000	0.9000	263.8405
South East	1.1300	127.3119	0.7100	0.7000	0.9000	57.9147
South	1.3000	118.5567	0.7100	0.7000	0.9000	62.0456
South West	8.2600	127.3119	0.7100	0.7000	0.9000	423.3410
West	1.9900	125.2818	0.7100	0.7000	0.9000	100.3650
North West	2.3600	106.0502	0.7100	0.7000	0.9000	100.7546
North East	4.1000	106.0502	0.7100	0.7000	0.9000	175.0398
total:						1207.5148

Jun

Jul

Aug

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Solar gains	1302	1208	1059	(P3)
Internal gains	615	590	600	
Total summer gains	1917	1798	1659	(P5)
Summer gain/loss ratio	3.38	3.17	2.93	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 147.3)	0.97	0.97	0.97	
Threshold temperature	19.75	21.44	21.20	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			