

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	Q12433 P2			Issued on Date	30/10/2023
Assessment Reference	Fabric	Prop Type Ref	New Build		
Property	Plot 2, 31, Beech Hill Avenue, Barnet, Hertfordshire, EN4 0LU				
SAP Rating	88 B	DER	12.13	TER	12.96
Environmental	86 B	% DER<TER	6.39		
CO₂ Emissions (t/year)	3.93	DFEE	45.72	TFEE	56.06
General Requirements Compliance	Pass	% DFEE<TFEE	18.46		
Assessor Details	Mr. Joe Cantwell Dillon, Joe Dillon, Tel: , joe.dillon@atspaceltd.com			Assessor ID	BL89-0001
Client	Town & Country Planning Ltd, Q-02404				

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

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DWELLING AS DESIGNED

Detached House, total floor area 379 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) 12.96 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.13 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)56.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.30 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.40 (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: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
Design Stage Gas boiler

Efficiency: 90.0% SEDBUK2009
Minimum: 88.0%

OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 2.86 kWh/day
Permitted by DBSCG 2.86 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 (Thames Valley): Medium OK

Based on:

Overshading: Average
Windows facing North East: 26.92 m², No overhang
Windows facing South East: 1.05 m², No overhang
Windows facing South West: 40.68 m², No overhang
Windows facing North West: 4.20 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

External wall U-value 0.13 W/m²K
Thermal bridging y-value 0.024 W/m²K

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1029.8641 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					7 * 10 = 70.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 70.0000 / (5) = 0.0680 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3180 (18)							
Number of sides sheltered					2 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2703 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.3446	0.3378	0.3311	0.2973	0.2905	0.2568	0.2568	0.2500	0.2703	0.2905	0.3041	0.3176 (22b)
Effective ac	0.5594	0.5571	0.5548	0.5442	0.5422	0.5330	0.5330	0.5313	0.5365	0.5422	0.5462	0.5504 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m ²)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	240.6057		(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			18.0000	2403.1800 (32e)					
Internal Ceiling 2			67.3700			18.0000	1212.6600 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 51886.4400 (34)					
Thermal mass parameter (TMP) = Cm / TFA in kJ/m ² K							136.7736 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.8414 (36)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 190.1063	Feb 189.3228	Mar 188.5547	Apr 184.9472	May 184.2723	Jun 181.1302	Jul 181.1302	Aug 180.5484	Sep 182.3405	Oct 184.2723	Nov 185.6377	Dec 187.0652 (38)
Heat transfer coeff	448.5535	447.7699	447.0019	443.3944	442.7194	439.5774	439.5774	438.9955	440.7877	442.7194	444.0848	445.5123 (39)
Average = Sum(39)m / 12 =												443.3911 (39)
HLP	Jan 1.1824	Feb 1.1803	Mar 1.1783	Apr 1.1688	May 1.1670	Jun 1.1587	Jul 1.1587	Aug 1.1572	Sep 1.1619	Oct 1.1670	Nov 1.1706	Dec 1.1744 (40)
HLP (average)												1.1688 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

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Assumed occupancy 3.2351 (42)
Average daily hot water use (litres/day) 111.0336 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369	(44)
Energy content (annual)	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104	(45)
Energy content (annual)	Total = Sum(45)m = 1746.9905 (45)												
Distribution loss (46)m = 0.15 x (45)m	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116	(46)
Water storage loss:													
Store volume													
a) If manufacturer declared loss factor is known (kWh/day):													
Temperature factor from Table 2b													
Enter (49) or (54) in (55)													
Total storage loss													
47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	46.3320	(56)
If cylinder contains dedicated solar storage													
47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	46.3320	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)
Total per year (kWh/year) = Sum(64)m =	2584.5925 (64)												
Heat gains from water heating, kWh/month	117.1353	104.0760	111.2644	102.4617	102.3795	94.3111	93.2688	98.6321	97.2946	106.1137	108.7837	115.2350	(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	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	46.3368	41.1560	33.4703	25.3391	18.9413	15.9911	17.2789	22.4598	30.1454	38.2766	44.6744	47.6247	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	519.7581	525.1516	511.5603	482.6259	446.1014	411.7736	388.8405	383.4470	397.0384	425.9727	462.4972	496.8250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	(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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	(71)
Water heating gains (Table 5)	157.4399	154.8750	149.5489	142.3080	137.6069	130.9876	125.3613	132.5701	135.1314	142.6259	151.0885	154.8858	(72)
Total internal gains	798.0613	795.7091	769.1059	724.7995	677.1761	633.2787	606.0072	613.0033	636.8416	681.4017	732.7866	773.8619	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	26.9200	11.2829	0.5500	0.0000	0.7700	128.6325 (75)
Southeast	1.0500	36.7938	0.5500	0.0000	0.7700	16.3613 (77)
Southwest	40.6800	36.7938	0.5500	0.0000	0.7700	633.8834 (79)
Northwest	4.2000	11.2829	0.5500	0.0000	0.7700	20.0690 (81)
Northeast	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)
Southeast	1.5800	38.2331	0.6300	0.7000	1.0000	23.9760 (82)
Northwest	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)
Horizontal	9.5000	26.0000	0.6300	0.7000	1.0000	98.0343 (82)

Solar gains 942.7969 1704.5126 2578.4722 3582.2342 4347.5815 4458.6625 4239.6781 3650.1566 2924.8684 1951.7575 1147.5831 794.7727 (83)
Total gains 1740.8582 2500.2217 3347.5780 4307.0336 5024.7576 5091.9411 4845.6853 4263.1599 3561.7101 2633.1592 1880.3697 1568.6346 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	21.0000 (85)												
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.1320	32.1882	32.2435	32.5058	32.5554	32.7881	32.7881	32.8315	32.6981	32.5554	32.4553	32.3513	
alpha	3.1421	3.1459	3.1496	3.1671	3.1704	3.1859	3.1859	3.1888	3.1799	3.1704	3.1637	3.1568	
util living area	0.9922	0.9764	0.9355	0.8360	0.6799	0.5118	0.3860	0.4496	0.6977	0.9194	0.9837	0.9943	(86)
MIT	19.2625	19.5471	19.9533	20.4073	20.7133	20.8556	20.8971	20.8859	20.7549	20.2866	19.6718	19.2128	(87)
Th 2	19.9341	19.9358	19.9374	19.9450	19.9465	19.9532	19.9532	19.9544	19.9506	19.9465	19.9436	19.9406	(88)
util rest of house	0.9905	0.9717	0.9230	0.8064	0.6285	0.4400	0.2994	0.3565	0.6274	0.8977	0.9798	0.9931	(89)
MIT 2	17.5888	18.0030	18.5864	19.2204	19.6144	19.7817	19.8195	19.8135	19.6812	19.0741	18.1927	17.5207	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	17.8521	18.2460	18.8014	19.4071	19.7872	19.9506	19.9890	19.9822	19.8501	19.2649	18.4254	17.7869	(92)
Temperature adjustment	-0.1500												
adjusted MIT	17.7021	18.0960	18.6514	19.2571	19.6372	19.8006	19.8390	19.8322	19.7001	19.1149	18.2754	17.6369	(93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9854	0.9603	0.9035	0.7838	0.6120	0.4290	0.2896	0.3450	0.6085	0.8754	0.9707	0.9892	(94)	
Useful gains	1715.5257	2401.0318	3024.5494	3375.8578	3075.2394	2184.2908	1403.3580	1470.9070	2167.2868	2305.1959	1825.2041	1551.6861	(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														
	6011.5397	5908.7525	5431.7160	4592.2733	3513.9731	2286.0880	1423.7918	1506.7064	2468.4702	3769.6981	4962.8158	5986.3162	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)	
Space heating kWh														
	3196.2345	2357.1884	1790.9320	875.8192	326.4179	0.0000	0.0000	0.0000	0.0000	1089.5897	2259.0805	3299.3648	(98)	
Space heating												15194.6268	(98)	
Space heating per m2												(98) / (4) =	40.0533	(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 %)													93.3000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													16285.7737	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	3196.2345	2357.1884	1790.9320	875.8192	326.4179	0.0000	0.0000	0.0000	0.0000	1089.5897	2259.0805	3299.3648	(98)	
Space heating efficiency (main heating system 1)	93.3000	93.3000	93.3000	93.3000	93.3000	0.0000	0.0000	0.0000	0.0000	93.3000	93.3000	93.3000	(210)	
Space heating fuel (main heating system)	3425.7604	2526.4613	1919.5412	938.7130	349.8584	0.0000	0.0000	0.0000	0.0000	1167.8346	2421.3081	3536.2967	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)	
Efficiency of water heater	90.0763	89.9298	89.6027	88.7434	86.6841	80.8000	80.8000	80.8000	80.8000	89.0366	89.8605	90.1168	(217)	
Fuel for water heating, kWh/month	280.0562	247.6021	261.8307	238.1697	239.8203	231.2458	223.3732	243.3364	242.3510	246.0973	256.3676	273.5886	(219)	
Water heating fuel used												2983.8388	(219)	
Annual totals kWh/year														
Space heating fuel - main system													16285.7737	(211)
Space heating fuel - secondary													0.0000	(215)
Electricity for pumps and fans:														
central heating pump													30.0000	(230c)
Total electricity for the above, kWh/year													30.0000	(231)
Electricity for lighting (calculated in Appendix L)													818.3227	(232)
Total delivered energy for all uses													20117.9352	(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	16285.7737	0.2160	3517.7271	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2983.8388	0.2160	644.5092	(264)
Space and water heating			4162.2363	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	818.3227	0.5190	424.7095	(268)
Total CO2, kg/year			4602.5158	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.1300	(273)

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

DER			12.1300	ZC1
Total Floor Area		TFA	379.3600	
Assumed number of occupants		N	3.2351	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			8.1189	ZC2
CO2 emissions from cooking, equation (L16)			0.5184	ZC3
Total CO2 emissions			20.7672	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			20.7672	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					4 * 10 = 40.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.0388 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.2888 (18)							
Number of sides sheltered					2 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2455 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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 infiltr rate	0.3130	0.3069	0.3008	0.2701	0.2639	0.2332	0.2332	0.2271	0.2455	0.2639	0.2762	0.2885 (22b)
Effective ac	0.5490	0.5471	0.5452	0.5365	0.5348	0.5272	0.5272	0.5258	0.5301	0.5348	0.5381	0.5416 (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			2.0000	1.0000	2.0000		(26)					
TER Opening Type (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
TER Room Window (Uw = 1.70)			14.2400	1.5918	22.6667		(27a)					
Heat Loss Floor 1			190.3800	0.1300	24.7494		(28a)					
External Wall 1	325.2500	71.4700	253.7800	0.1800	45.6804		(29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.1800	2.3814		(29a)					
Ashlar Wall	29.6900		29.6900	0.1800	5.3442		(29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1300	5.0076		(30)					
Slope Roof	68.2900	4.7400	63.5500	0.1300	8.2615		(30)					
Dormer Roof	6.9500		6.9500	0.1300	0.9035		(30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982		(30)					
Total net area of external elements Aum(A, m ²)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	222.1743	(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)							28.2408 (36)					
Total fabric heat loss							(33) + (36) = 250.4151 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 186.5784	Feb 185.9319	Mar 185.2981	Apr 182.3213	May 181.7644	Jun 179.1717	Jul 179.1717	Aug 178.6915	Sep 180.1703	Oct 181.7644	Nov 182.8911	Dec 184.0690 (38)
Heat transfer coeff	436.9936	436.3470	435.7132	432.7364	432.1795	429.5868	429.5868	429.1066	430.5854	432.1795	433.3062	434.4841 (39)
Average = Sum(39)m / 12 =												432.7337 (39)
HLP	Jan 1.1519	Feb 1.1502	Mar 1.1485	Apr 1.1407	May 1.1392	Jun 1.1324	Jul 1.1324	Aug 1.1311	Sep 1.1350	Oct 1.1392	Nov 1.1422	Dec 1.1453 (40)
HLP (average)												1.1407 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												3.2351 (42)
Average daily hot water use (litres/day)												111.0336 (43)
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy conte	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1746.9905 (45)
Distribution loss (46)m = 0.15 x (45)m														
	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116	(46)	
Water storage loss:														
Store volume														300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):														2.1127 (48)
Temperature factor from Table 2b														0.5400 (49)
Enter (49) or (54) in (55)														1.1409 (55)
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)	
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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														
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	239.7544	211.3686	222.0974	199.2535	195.3762	174.7402	167.9756	184.1058	183.7132	206.6066	218.2669	234.0392	(64)	
Total per year (kWh/year) = Sum(64)m =														2437.2975 (64)
Heat gains from water heating, kWh/month	107.1273	95.0366	101.2564	92.7766	92.3716	84.6259	83.2608	88.6242	87.6094	96.1057	99.0986	105.2270	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	46.3368	41.1560	33.4703	25.3391	18.9413	15.9911	17.2789	22.4598	30.1454	38.2766	44.6744	47.6247	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	519.7581	525.1516	511.5603	482.6259	446.1014	411.7736	388.8405	383.4470	397.0384	425.9727	462.4972	496.8250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	(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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	(71)
Water heating gains (Table 5)	143.9883	141.4234	136.0973	128.8564	124.1553	117.5360	111.9097	119.1185	121.6798	129.1743	137.6369	141.4342	(72)
Total internal gains	784.6097	782.2575	755.6543	711.3479	663.7245	619.8271	592.5556	599.5517	623.3900	667.9501	719.3350	760.4103	(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						
Northeast			26.9200	11.2829	0.6300	0.7000	0.7700			92.8259 (75)			
Southeast			1.0500	36.7938	0.6300	0.7000	0.7700			11.8069 (77)			
Southwest			40.6800	36.7938	0.6300	0.7000	0.7700			457.4333 (79)			
Northwest			4.2000	11.2829	0.6300	0.7000	0.7700			14.4825 (81)			
Northeast			1.5800	17.4137	0.6300	0.7000	1.0000			10.9202 (82)			
Southeast			1.5800	38.2331	0.6300	0.7000	1.0000			23.9760 (82)			
Northwest			1.5800	17.4137	0.6300	0.7000	1.0000			10.9202 (82)			
Horizontal			9.5000	26.0000	0.6300	0.7000	1.0000			98.0343 (82)			
Solar gains	720.3993	1311.9382	2004.8146	2810.2313	3427.0014	3520.1630	3345.0921	2870.1732	2283.1147	1508.0324	878.6983	606.0669	(83)
Total gains	1505.0090	2094.1957	2760.4689	3521.5792	4090.7259	4139.9900	3937.6476	3469.7250	2906.5047	2175.9824	1598.0332	1366.4772	(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	60.2857	60.3750	60.4628	60.8787	60.9572	61.3251	61.3251	61.3937	61.1829	60.9572	60.7987	60.6339	
alpha	5.0190	5.0250	5.0309	5.0586	5.0638	5.0883	5.0883	5.0929	5.0789	5.0638	5.0532	5.0423	
util living area	0.9997	0.9984	0.9912	0.9516	0.8276	0.6338	0.4740	0.5546	0.8445	0.9867	0.9991	0.9998	(86)
MIT	19.5663	19.7785	20.1131	20.5326	20.8428	20.9688	20.9941	20.9876	20.8718	20.4177	19.9026	19.5299	(87)
Th 2	19.9587	19.9600	19.9614	19.9677	19.9689	19.9745	19.9745	19.9755	19.9723	19.9689	19.9665	19.9640	(88)
util rest of house	0.9996	0.9978	0.9879	0.9339	0.7740	0.5447	0.3667	0.4383	0.7723	0.9796	0.9987	0.9998	(89)
MIT 2	18.0237	18.3350	18.8232	19.4226	19.8209	19.9549	19.9724	19.9706	19.8692	19.2723	18.5216	17.9742	(90)
Living area fraction													fLA = Living area / (4) =
MIT	18.2664	18.5621	19.0261	19.5973	19.9817	20.1144	20.1331	20.1306	20.0269	19.4525	18.7389	18.2189	(92)
Temperature adjustment													0.0000
adjusted MIT	18.2664	18.5621	19.0261	19.5973	19.9817	20.1144	20.1331	20.1306	20.0269	19.4525	18.7389	18.2189	(93)

8. Space heating requirement

Utilisation	0.9993	0.9966	0.9837	0.9259	0.7748	0.5574	0.3836	0.4565	0.7768	0.9744	0.9979	0.9996	(94)
Useful gains	1504.0021	2087.1025	2715.5146	3260.5037	3169.2938	2307.6909	1510.4670	1583.8895	2257.8128	2120.2911	1594.7498	1365.9117	(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	6103.2147	5961.4218	5457.7973	4629.0901	3579.1701	2368.9079	1517.7846	1600.8161	2552.0406	3825.8617	5043.2043	6090.9994	(97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	3421.8142	2603.5426	2040.2584	985.3822	304.9480	0.0000	0.0000	0.0000	0.0000	1268.9445	2482.8872	3515.4652 (98)
Space heating												16623.2423 (98)
Space heating per m2											(98) / (4) =	43.8192 (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 %)												93.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												17778.8688 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	3421.8142	2603.5426	2040.2584	985.3822	304.9480	0.0000	0.0000	0.0000	0.0000	1268.9445	2482.8872	3515.4652 (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)	3659.6943	2784.5375	2182.0945	1053.8847	326.1476	0.0000	0.0000	0.0000	0.0000	1357.1599	2655.4944	3759.8559 (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	239.7544	211.3686	222.0974	199.2535	195.3762	174.7402	167.9756	184.1058	183.7132	206.6066	218.2669	234.0392 (64)
Efficiency of water heater (217)m	89.7124	89.5979	89.3242	88.5040	85.9972	79.8000	79.8000	79.8000	79.8000	88.8322	89.5300	79.8000 (216)
Fuel for water heating, kWh/month	267.2479	235.9080	248.6419	225.1350	227.1891	218.9726	210.4957	230.7090	230.2170	232.5808	243.7920	260.7713 (219)
Water heating fuel used												2831.6603 (219)
Annual totals kWh/year												
Space heating fuel - main system												17778.8688 (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)												818.3227 (232)
Total delivered energy for all uses												21503.8518 (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	17778.8688	0.2160	3840.2357 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2831.6603	0.2160	611.6386 (264)
Space and water heating			4451.8743 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	818.3227	0.5190	424.7095 (268)
Total CO2, kg/m2/year			4915.5088 (272)
Emissions per m2 for space and water heating			11.7352 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.1195 (272b)
Emissions per m2 for pumps and fans			0.1026 (272c)
Target Carbon Dioxide Emission Rate (TER) = (11.7352 * 1.00) + 1.1195 + 0.1026, rounded to 2 d.p.			12.9600 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (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)							
					Air changes per hour							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.0388 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.2888 (18)							
Number of sides sheltered					2 (19)							
					Shelter factor							
Infiltration rate adjusted to include shelter factor					(20) = 1 - [0.075 x (19)] = 0.8500 (20) (21) = (18) x (20) = 0.2455 (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)
Effective ac	0.3130	0.3069	0.3008	0.2701	0.2639	0.2332	0.2332	0.2271	0.2455	0.2639	0.2762	0.2885 (22b)
	0.5490	0.5471	0.5452	0.5365	0.5348	0.5272	0.5272	0.5258	0.5301	0.5348	0.5381	0.5416 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m2)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 240.6057		(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			9.0000	1201.5900 (32e)					
Internal Ceiling 2			67.3700			9.0000	606.3300 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 50078.5200 (34)					
Thermal mass parameter (TMP) = Cm / TFA in kJ/m2K							132.0079 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.8414 (36)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	186.5784	185.9319	185.2981	182.3213	181.7644	179.1717	179.1717	178.6915	180.1703	181.7644	182.8911	184.0690 (38)
Average = Sum(39)m / 12 =	445.0256	444.3790	443.7453	440.7685	440.2115	437.6188	437.6188	437.1387	438.6175	440.2115	441.3382	442.5161 (39)
												440.7658 (39)
HLP												
HLP (average)	1.1731	1.1714	1.1697	1.1619	1.1604	1.1536	1.1536	1.1523	1.1562	1.1604	1.1634	1.1665 (40)
Days in month												1.1619 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Assumed occupancy												3.2351 (42)
Average daily hot water use (litres/day)												111.0336 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy conte	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)
Energy content (annual)												Total = Sum(45)m = 1746.9905 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	38.4892	33.6629	34.7371	30.2846	29.0588	25.0756	23.2362	26.6639	26.9823	31.4453	34.3250	37.2747 (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	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	46.3368	41.1560	33.4703	25.3391	18.9413	15.9911	17.2789	22.4598	30.1454	38.2766	44.6744	47.6247 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	519.7581	525.1516	511.5603	482.6259	446.1014	411.7736	388.8405	383.4470	397.0384	425.9727	462.4972	496.8250 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755 (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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039 (71)
Water heating gains (Table 5)	51.7328	50.0936	46.6896	42.0620	39.0576	34.8272	31.2314	35.8385	37.4754	42.2652	47.6736	50.1004 (72)
Total internal gains	689.3542	687.9276	663.2466	621.5535	575.6267	534.1183	508.8773	513.2718	536.1857	578.0409	626.3717	666.0766 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W						
Northeast	26.9200	11.2829	0.5500	0.0000	0.7700	128.6325 (75)						
Southeast	1.0500	36.7938	0.5500	0.0000	0.7700	16.3613 (77)						
Southwest	40.6800	36.7938	0.5500	0.0000	0.7700	633.8834 (79)						
Northwest	4.2000	11.2829	0.5500	0.0000	0.7700	20.0690 (81)						
Northeast	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)						
Southeast	1.5800	38.2331	0.6300	0.7000	1.0000	23.9760 (82)						
Northwest	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)						
Horizontal	9.5000	26.0000	0.6300	0.7000	1.0000	98.0343 (82)						
Solar gains	942.7969	1704.5126	2578.4722	3582.2342	4347.5815	4458.6625	4239.6781	3650.1566	2924.8684	1951.7575	1147.5831	794.7727 (83)
Total gains	1632.1511	2392.4402	3241.7188	4203.7876	4923.2083	4992.7807	4748.5554	4163.4284	3461.0541	2529.7985	1773.9548	1460.8493 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	31.2582	31.3037	31.3484	31.5601	31.6000	31.7873	31.7873	31.8222	31.7149	31.6000	31.5194	31.4355
alpha	3.0839	3.0869	3.0899	3.1040	3.1067	3.1192	3.1192	3.1215	3.1143	3.1067	3.1013	3.0957
util living area	0.9927	0.9771	0.9365	0.8377	0.6829	0.5162	0.3907	0.4559	0.7040	0.9223	0.9847	0.9948 (86)
MIT	18.7202	19.1095	19.6656	20.2870	20.7118	20.9119	20.9723	20.9555	20.7675	20.1162	19.2740	18.6493 (87)
Th 2	19.9416	19.9430	19.9443	19.9506	19.9518	19.9573	19.9573	19.9583	19.9552	19.9518	19.9494	19.9469 (88)
util rest of house	0.9912	0.9727	0.9244	0.8089	0.6324	0.4449	0.3039	0.3626	0.6351	0.9018	0.9811	0.9937 (89)
MIT 2	17.8456	18.2327	18.7784	19.3719	19.7473	19.9087	19.9469	19.9402	19.8093	19.2292	18.4033	17.7787 (90)
Living area fraction												FLA = Living area / (4) = 0.1573 (91)
MIT	17.9832	18.3706	18.9180	19.5159	19.8991	20.0666	20.1082	20.1000	19.9601	19.3687	18.5402	17.9157 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9832	18.3706	18.9180	19.5159	19.8991	20.0666	20.1082	20.1000	19.9601	19.3687	18.5402	17.9157 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9873	0.9638	0.9098	0.7952	0.6296	0.4527	0.3168	0.3758	0.6355	0.8874	0.9743	0.9907 (94)
Useful gains	1611.4563	2305.7303	2949.2436	3342.9129	3099.7200	2260.3388	1504.2833	1564.6275	2199.4030	2244.9681	1728.4409	1447.3136 (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	6089.3829	5986.0655	5510.4256	4679.1448	3609.3223	2392.2708	1535.2705	1617.3927	2570.3296	3860.0798	5049.0130	6069.4168 (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	3331.5774	2473.1853	1905.5194	962.0869	379.1441	0.0000	0.0000	0.0000	0.0000	1201.6430	2390.8120	3438.8448 (98)
Space heating												16082.8129 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating per m2

(98) / (4) = 42.3946 (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	0.0000	4113.6168	3238.3792	3322.2539	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8703	0.9133	0.8806	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9460	2957.4950	2925.5623	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5839.6145	5559.3914	4909.8712	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	0.0000	1626.9613	1935.8109	1476.3258	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction													5039.0980
Intermittency factor (Table 10b)													1.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(105)
Space cooling kWh													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	406.7403	483.9527	369.0815	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling													
Space cooling per m2													1259.7745
Energy for space heating													3.3208
Energy for space cooling													42.3946
Total													3.3208
Dwelling Fabric Energy Efficiency (DFEE)													45.7154
													45.7

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (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)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.0388 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2888 (18)
Number of sides sheltered					2 (19)
					Shelter factor
Infiltration rate adjusted to include shelter factor					(20) = 1 - [0.075 x (19)] = 0.8500 (20) (21) = (18) x (20) = 0.2455 (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												
Effective ac	0.3130	0.3069	0.3008	0.2701	0.2639	0.2332	0.2332	0.2271	0.2455	0.2639	0.2762	0.2885 (22b)
	0.5490	0.5471	0.5452	0.5365	0.5348	0.5272	0.5272	0.5258	0.5301	0.5348	0.5381	0.5416 (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			2.0000	1.0000	2.0000		(26)
TER Opening Type (Uw = 1.40)			72.8500	1.3258	96.5814		(27)
TER Room Window (Uw = 1.70)			14.2400	1.5918	22.6667		(27a)
Heat Loss Floor 1			190.3800	0.1300	24.7494		(28a)
External Wall 1	325.2500	71.4700	253.7800	0.1800	45.6804		(29a)
Dormer Cheeks	16.6100	3.3800	13.2300	0.1800	2.3814		(29a)
Ashlar Wall	29.6900		29.6900	0.1800	5.3442		(29a)
Flat Roof	48.0200	9.5000	38.5200	0.1300	5.0076		(30)
Slope Roof	68.2900	4.7400	63.5500	0.1300	8.2615		(30)
Dormer Roof	6.9500		6.9500	0.1300	0.9035		(30)
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982		(30)
Total net area of external elements Aum(A, m2)			751.3300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 222.1743		(33)
							Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K
							250.0000 (35)
							Thermal bridges (Sum(L x Psi) calculated using Appendix K)
							28.2408 (36)
							Total fabric heat loss
							(33) + (36) = 250.4151 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	186.5784	185.9319	185.2981	182.3213	181.7644	179.1717	179.1717	178.6915	180.1703	181.7644	182.8911	184.0690 (38)
Average = Sum(39)m / 12 =	436.9936	436.3470	435.7132	432.7364	432.1795	429.5868	429.5868	429.1066	430.5854	432.1795	433.3062	434.4841 (39)
												432.7337 (39)
HLP	1.1519	1.1502	1.1485	1.1407	1.1392	1.1324	1.1324	1.1311	1.1350	1.1392	1.1422	1.1453 (40)
HLP (average)												1.1407 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												3.2351 (42)
Average daily hot water use (litres/day)												111.0336 (43)
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy conte	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1746.9905 (45)		
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	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	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	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	38.4892	33.6629	34.7371	30.2846	29.0588	25.0756	23.2362	26.6639	26.9823	31.4453	34.3250	37.2747			(65)

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

Metabolic gains (Table 5), Watts														
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	161.7549	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	46.3368	41.1560	33.4703	25.3391	18.9413	15.9911	17.2789	22.4598	30.1454	38.2766	44.6744	47.6247	47.6247	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	519.7581	525.1516	511.5603	482.6259	446.1014	411.7736	388.8405	383.4470	397.0384	425.9727	462.4972	496.8250	496.8250	(68)
Pumps, fans	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	39.1755	(69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	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)
Water heating gains (Table 5)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	(71)
Total internal gains	689.3542	687.9276	663.2466	621.5535	575.6267	534.1183	508.8773	513.2718	536.1857	578.0409	626.3717	666.0766	666.0766	(73)

6. Solar gains

[Jan]	Area	Solar flux	Specific data	Specific data	Access factor	Gains								
	m2	Table 6a	g	Specific data	Table 6d	W								
		W/m2	or Table 6b	or Table 6c										
Northeast	26.9200	11.2829	0.6300	0.7000	0.7700	92.8259 (75)								
Southeast	1.0500	36.7938	0.6300	0.7000	0.7700	11.8069 (77)								
Southwest	40.6800	36.7938	0.6300	0.7000	0.7700	457.4333 (79)								
Northwest	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825 (81)								
Northeast	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)								
Southeast	1.5800	38.2331	0.6300	0.7000	1.0000	23.9760 (82)								
Northwest	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)								
Horizontal	9.5000	26.0000	0.6300	0.7000	1.0000	98.0343 (82)								
Solar gains	720.3993	1311.9382	2004.8146	2810.2313	3427.0014	3520.1630	3345.0921	2870.1732	2283.1147	1508.0324	878.6983	606.0669	606.0669	(83)
Total gains	1409.7535	1999.8658	2668.0612	3431.7848	4002.6281	4054.2812	3853.9693	3383.4450	2819.3004	2086.0733	1505.0699	1272.1435	1272.1435	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)														
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
alpha	60.2857	60.3750	60.4628	60.8787	60.9572	61.3251	61.3251	61.3937	61.1829	60.9572	60.7987	60.6339	60.6339	
util living area	5.0190	5.0250	5.0309	5.0586	5.0638	5.0883	5.0883	5.0929	5.0789	5.0638	5.0532	5.0423	5.0423	
	0.9998	0.9987	0.9924	0.9559	0.8368	0.6448	0.4837	0.5672	0.8566	0.9889	0.9993	0.9999	0.9999	(86)
MIT	19.5428	19.7553	20.0912	20.5151	20.8339	20.9664	20.9935	20.9864	20.8620	20.3968	19.8797	19.5066	19.5066	(87)
Th 2	19.9587	19.9600	19.9614	19.9677	19.9689	19.9745	19.9745	19.9755	19.9723	19.9689	19.9665	19.9640	19.9640	(88)
util rest of house	0.9997	0.9982	0.9895	0.9395	0.7844	0.5550	0.3745	0.4490	0.7869	0.9828	0.9990	0.9998	0.9998	(89)
MIT 2	18.6140	18.8275	19.1627	19.5795	19.8613	19.9599	19.9729	19.9717	19.8954	19.4731	18.9571	18.5821	18.5821	(90)
Living area fraction	18.7601	18.9734	19.3088	19.7267	20.0143	20.1183	20.1335	20.1314	20.0474	19.6184	19.1023	18.7275	18.7275	(91)
Temperature adjustment	18.7601	18.9734	19.3088	19.7267	20.0143	20.1183	20.1335	20.1314	20.0474	19.6184	19.1023	18.7275	18.7275	(92)
adjusted MIT	18.7601	18.9734	19.3088	19.7267	20.0143	20.1183	20.1335	20.1314	20.0474	19.6184	19.1023	18.7275	18.7275	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	0.9996	0.9976	0.9871	0.9347	0.7870	0.5683	0.3918	0.4677	0.7929	0.9799	0.9986	0.9998	0.9998	(94)
Ext temp.	1409.1652	1995.0569	2633.6695	3207.7188	3150.0621	2303.8605	1509.8729	1582.2814	2235.3847	2044.2087	1503.0364	1271.8278	1271.8278	(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	4.2000	(96)
Month fracti	6318.9806	6140.8959	5580.9652	4685.1130	3593.2629	2370.5700	1517.9322	1601.1528	2560.8808	3897.5790	5200.6495	6311.9778	6311.9778	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	3652.9027	2786.0038	2192.7880	1063.7238	329.7414	0.0000	0.0000	0.0000	0.0000	1378.9075	2662.2814	3749.8716	3749.8716	(98)
													17816.2202 (98)	
													(98) / (4) = 46.9639 (99)	

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	4038.1156	3178.9421	3261.2104	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8950	0.9437	0.9082	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3614.2372	2999.8336	2961.6795	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	4742.6670	4513.7713	3998.2023	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	812.4695	1126.3697	771.1730	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												2710.0122 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
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	203.1174	281.5924	192.7932	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												677.5030 (107)
Energy for space heating												1.7859 (108)
Energy for space cooling												46.9639 (99)
Total												1.7859 (108)
Target Fabric Energy Efficiency (TFEE)												48.7498 (109)
												56.1 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	2.8500 (2b)	508.6680 (1b) - (3b)
First floor	133.5100 (1c)	2.9400 (2c)	392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	1.9100 (2d)	128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				7 * 10 =	70.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour							
Pressure test					70.0000 / (5) =							
Measured/design AP50					Yes							
Infiltration rate					5.0000							
Number of sides sheltered					0.3180 (18)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2703 (21)							
Wind speed	Jan 4.7000	Feb 4.4000	Mar 4.5000	Apr 4.0000	May 4.1000	Jun 3.5000	Jul 3.7000	Aug 3.9000	Sep 3.8000	Oct 4.1000	Nov 4.0000	Dec 4.4000 (22)
Wind factor	1.1750	1.1000	1.1250	1.0000	1.0250	0.8750	0.9250	0.9750	0.9500	1.0250	1.0000	1.1000 (22a)
Adj infilt rate	0.3176	0.2973	0.3041	0.2703	0.2770	0.2365	0.2500	0.2635	0.2568	0.2770	0.2703	0.2973 (22b)
Effective ac	0.5504	0.5442	0.5462	0.5365	0.5384	0.5280	0.5313	0.5347	0.5330	0.5384	0.5365	0.5442 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m2)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	240.6057	(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			18.0000	2403.1800 (32e)					
Internal Ceiling 2			67.3700			18.0000	1212.6600 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 51886.4400 (34)					
Thermal mass parameter (TMP) = Cm / TFA in kJ/m2K							136.7736 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.8414 (36)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 187.0652	Feb 184.9472	Mar 185.6377	Apr 182.3405	May 182.9689	Jun 179.4312	Jul 180.5484	Aug 181.7276	Sep 181.1302	Oct 182.9689	Nov 182.3405	Dec 184.9472 (38)
Heat transfer coeff	445.5123	443.3944	444.0848	440.7877	441.4161	437.8784	438.9955	440.1748	439.5774	441.4161	440.7877	443.3944 (39)
Average = Sum(39)m / 12 =												441.4516 (39)
HLP	Jan 1.1744	Feb 1.1688	Mar 1.1706	Apr 1.1619	May 1.1636	Jun 1.1543	Jul 1.1572	Aug 1.1603	Sep 1.1587	Oct 1.1636	Nov 1.1619	Dec 1.1688 (40)
HLP (average)												1.1637 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Assumed occupancy												3.2351 (42)
Average daily hot water use (litres/day)												111.0336 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy content (annual)	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)
Distribution loss (46)m = 0.15 x (45)m	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.8600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.5444 (55)
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (64)
RHI water heating demand												2584.5925 (64)
Heat gains from water heating, kWh/month	117.1353	104.0760	111.2644	102.4617	102.3795	94.3111	93.2688	98.6321	97.2946	106.1137	108.7837	115.2350 (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	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	115.8420	102.8899	83.6757	63.3479	47.3533	39.9776	43.1972	56.1494	75.3636	95.6914	111.6860	119.0617 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	775.7584	783.8084	763.5228	720.3371	665.8230	614.5874	580.3589	572.3090	592.5946	635.7802	690.2943	741.5299 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457 (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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039 (71)
Water heating gains (Table 5)	157.4399	154.8750	149.5489	142.3080	137.6069	130.9876	125.3613	132.5701	135.1314	142.6259	151.0885	154.8858 (72)
Total internal gains	1174.3880	1166.9209	1122.0949	1051.3406	976.1308	910.9003	874.2651	886.3761	928.4372	999.4452	1078.4165	1140.8250 (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							
Northeast	26.9200	12.9280	0.5500	0.0000	0.7700	147.3876 (75)						
Southeast	1.0500	40.5720	0.5500	0.0000	0.7700	18.0414 (77)						
Southwest	40.6800	40.5720	0.5500	0.0000	0.7700	698.9738 (79)						
Northwest	4.2000	12.9280	0.5500	0.0000	0.7700	22.9951 (81)						
Northeast	1.5800	20.0673	0.6300	0.7000	1.0000	12.5843 (82)						
Southeast	1.5800	43.0800	0.6300	0.7000	1.0000	27.0155 (82)						
Northwest	1.5800	20.0673	0.6300	0.7000	1.0000	12.5843 (82)						
Horizontal	9.5000	30.0000	0.6300	0.7000	1.0000	113.1165 (82)						
Solar gains	1052.6985	1685.9542	2548.6749	3653.3290	4316.3688	4769.2607	4526.9074	3980.5893	3171.2188	2072.8042	1313.5466	878.3413 (83)
Total gains	2227.0865	2852.8751	3670.7698	4704.6696	5292.4997	5680.1609	5401.1725	4866.9654	4099.6560	3072.2494	2391.9631	2019.1663 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, T _{hl} (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.3513	32.5058	32.4553	32.6981	32.6515	32.9153	32.8315	32.7436	32.7881	32.6515	32.6981	32.5058
alpha	3.1568	3.1671	3.1637	3.1799	3.1768	3.1944	3.1888	3.1829	3.1859	3.1768	3.1799	3.1671
util living area	0.9824	0.9629	0.9072	0.7754	0.5973	0.3808	0.2496	0.2854	0.5619	0.8603	0.9636	0.9866 (86)
MIT	19.4956	19.7281	20.1357	20.5566	20.7959	20.8954	20.9119	20.9098	20.8445	20.4812	19.9152	19.4471 (87)
Th 2	19.9406	19.9450	19.9436	19.9506	19.9492	19.9568	19.9544	19.9519	19.9532	19.9492	19.9506	19.9450 (88)
util rest of house	0.9788	0.9557	0.8894	0.7374	0.5376	0.3074	0.1665	0.1938	0.4786	0.8247	0.9549	0.9838 (89)
MIT 2	17.9324	18.2705	18.8478	19.4208	19.7127	19.8206	19.8296	19.8262	19.7756	19.3390	18.5483	17.8653 (90)
Living area fraction												fLA = Living area / (4) = 0.1573 (91)
MIT	18.1783	18.4998	19.0504	19.5995	19.8831	19.9897	19.9999	19.9966	19.9437	19.5187	18.7633	18.1141 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0283	18.3498	18.9004	19.4495	19.7331	19.8397	19.8499	19.8466	19.7937	19.3687	18.6133	17.9641 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9695	0.9408	0.8676	0.7169	0.5245	0.2990	0.1581	0.1844	0.4649	0.8006	0.9397	0.9761 (94)
Useful gains	2159.0930	2684.1189	3184.7113	3372.6604	2775.8844	1698.2156	853.9600	897.4572	1906.1096	2459.6184	2247.8340	1970.8782 (95)
Ext temp.	5.0000	5.5000	7.4000	9.9000	12.9000	15.9000	17.9000	17.8000	15.2000	11.6000	7.9000	5.0000 (96)
Heat loss rate W												
Month fracti	5804.2617	5697.5257	5107.1661	4209.3069	3016.2542	1725.0883	855.9860	900.8800	2019.2954	3429.2221	4722.2987	5748.2092 (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	2712.0055	2025.0094	1430.3064	602.3855	178.8351	0.0000	0.0000	0.0000	0.0000	721.3852	1781.6146	2810.3342 (98)
RHI space heating demand												12261.8759 (98)
												12262 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (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					7 * 10 = 70.0000 (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) =					70.0000 / (5) = 0.0680 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3180 (18)							
Number of sides sheltered					2 (19)							
Shelter factor												
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.8500 (20)							
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.2703 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.3446	0.3378	0.3311	0.2973	0.2905	0.2568	0.2568	0.2500	0.2703	0.2905	0.3041	0.3176 (22b)
Effective ac	0.5594	0.5571	0.5548	0.5442	0.5422	0.5330	0.5330	0.5313	0.5365	0.5422	0.5462	0.5504 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m2)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 240.6057		(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			18.0000	2403.1800 (32e)					
Internal Ceiling 2			67.3700			18.0000	1212.6600 (32e)					
Heat capacity Cm = Sum(A x k)												
Thermal mass parameter (TMP) = Cm / TFA in kJ/m2K							(28)...(30) + (32) + (32a)...(32e) = 51886.4400 (34)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							136.7736 (35)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 190.1063	Feb 189.3228	Mar 188.5547	Apr 184.9472	May 184.2723	Jun 181.1302	Jul 181.1302	Aug 180.5484	Sep 182.3405	Oct 184.2723	Nov 185.6377	Dec 187.0652 (38)
Heat transfer coeff	448.5535	447.7699	447.0019	443.3944	442.7194	439.5774	439.5774	438.9955	440.7877	442.7194	444.0848	445.5123 (39)
Average = Sum(39)m / 12 =												443.3911 (39)
HLP	Jan 1.1824	Feb 1.1803	Mar 1.1783	Apr 1.1688	May 1.1670	Jun 1.1587	Jul 1.1587	Aug 1.1572	Sep 1.1619	Oct 1.1670	Nov 1.1706	Dec 1.1744 (40)
HLP (average)												1.1688 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Assumed occupancy 3.2351 (42)
Average daily hot water use (litres/day) 111.0336 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy content (annual)	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)
Energy content (annual)	Total = Sum(45)m = 1746.9905 (45)											
Distribution loss (46)m = 0.15 x (45)m	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116 (46)
Water storage loss:												
Store volume	300.0000 (47)											
a) If manufacturer declared loss factor is known (kWh/day):	2.8600 (48)											
Temperature factor from Table 2b	0.5400 (49)											
Enter (49) or (54) in (55)	1.5444 (55)											
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (64)
Total per year (kWh/year) = Sum(64)m =	2584.5925 (64)											
Heat gains from water heating, kWh/month	117.1353	104.0760	111.2644	102.4617	102.3795	94.3111	93.2688	98.6321	97.2946	106.1137	108.7837	115.2350 (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	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	115.8420	102.8899	83.6757	63.3479	47.3533	39.9776	43.1972	56.1494	75.3636	95.6914	111.6860	119.0617 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	775.7584	783.8084	763.5228	720.3371	665.8230	614.5874	580.3589	572.3090	592.5946	635.7802	690.2943	741.5299 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457 (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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039 (71)
Water heating gains (Table 5)	157.4399	154.8750	149.5489	142.3080	137.6069	130.9876	125.3613	132.5701	135.1314	142.6259	151.0885	154.8858 (72)
Total internal gains	1174.3880	1166.9209	1122.0949	1051.3406	976.1308	910.9003	874.2651	886.3761	928.4372	999.4452	1078.4165	1140.8250 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	26.9200	11.2829	0.5500	0.0000	0.7700	128.6325 (75)
Southeast	1.0500	36.7938	0.5500	0.0000	0.7700	16.3613 (77)
Southwest	40.6800	36.7938	0.5500	0.0000	0.7700	633.8834 (79)
Northwest	4.2000	11.2829	0.5500	0.0000	0.7700	20.0690 (81)
Northeast	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)
Southeast	1.5800	38.2331	0.6300	0.7000	1.0000	23.9760 (82)
Northwest	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)
Horizontal	9.5000	26.0000	0.6300	0.7000	1.0000	98.0343 (82)

Solar gains 942.7969 1704.5126 2578.4722 3582.2342 4347.5815 4458.6625 4239.6781 3650.1566 2924.8684 1951.7575 1147.5831 794.7727 (83)
Total gains 2117.1849 2871.4336 3700.5671 4633.5748 5323.7123 5369.5627 5113.9432 4536.5327 3853.3056 2951.2027 2225.9996 1935.5976 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.1320	32.1882	32.2435	32.5058	32.5554	32.7881	32.7881	32.8315	32.6981	32.5554	32.4553	32.3513
alpha	3.1421	3.1459	3.1496	3.1671	3.1704	3.1859	3.1859	3.1888	3.1799	3.1704	3.1637	3.1568
util living area	0.9864	0.9660	0.9186	0.8125	0.6554	0.4898	0.3674	0.4258	0.6645	0.8961	0.9743	0.9896 (86)
MIT	19.3660	19.6425	20.0302	20.4546	20.7342	20.8626	20.8995	20.8902	20.7767	20.3510	19.7635	19.3150 (87)
Th 2	19.9341	19.9358	19.9374	19.9450	19.9465	19.9532	19.9532	19.9544	19.9506	19.9465	19.9436	19.9406 (88)
util rest of house	0.9837	0.9595	0.9036	0.7806	0.6036	0.4199	0.2843	0.3364	0.5934	0.8700	0.9683	0.9875 (89)
MIT 2	17.7391	18.1399	18.6931	19.2810	19.6375	19.7877	19.8208	19.8161	19.7030	19.1601	18.3246	17.6695 (90)
Living area fraction	fLA = Living area / (4) = 0.1573 (91)											
MIT	17.9951	18.3763	18.9035	19.4656	19.8100	19.9568	19.9905	19.9851	19.8720	19.3474	18.5509	17.9283 (92)
Temperature adjustment	-0.1500											
adjusted MIT	17.8451	18.2263	18.7535	19.3156	19.6600	19.8068	19.8405	19.8351	19.7220	19.1974	18.4009	17.7783 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9454	0.8826	0.7588	0.5883	0.4096	0.2751	0.3257	0.5761	0.8467	0.9560	0.9812	(94)
Useful gains	2066.2916	2714.6842	3266.0955	3515.7764	3131.7562	2199.4743	1406.8718	1477.6473	2220.0357	2498.6667	2128.0585	1899.2131	(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													
	6075.6862	5967.1094	5477.3280	4618.2399	3524.0614	2288.7844	1424.4690	1507.9834	2478.0871	3806.2417	5018.5696	6049.3218	(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													
	2982.9895	2185.6298	1645.1570	793.7737	291.8750	0.0000	0.0000	0.0000	0.0000	972.8358	2081.1680	3087.6809	(98)
Space heating												14041.1097	(98)
Space heating per m2													(98) / (4) = 37.0126 (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 %)													93.3000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													15049.4209 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2982.9895	2185.6298	1645.1570	793.7737	291.8750	0.0000	0.0000	0.0000	0.0000	972.8358	2081.1680	3087.6809	(98)
Space heating efficiency (main heating system 1)	93.3000	93.3000	93.3000	93.3000	93.3000	0.0000	0.0000	0.0000	0.0000	93.3000	93.3000	93.3000	(210)
Space heating fuel (main heating system)	3197.2021	2342.5828	1763.2980	850.7757	312.8350	0.0000	0.0000	0.0000	0.0000	1042.6964	2230.6195	3309.4115	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)
Efficiency of water heater	90.0226	89.8614	89.5037	88.5719	86.4071	80.8000	80.8000	80.8000	80.8000	88.8582	89.7815	90.0675	(217)
Fuel for water heating, kWh/month	280.2234	247.7903	262.1204	238.6309	240.5891	231.2458	223.3732	243.3364	242.3510	246.5915	256.5933	273.7383	(219)
Water heating fuel used												2986.5836	(219)
Annual totals kWh/year													
Space heating fuel - main system													15049.4209 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
Total electricity for the above, kWh/year													30.0000 (231)
Electricity for lighting (calculated in Appendix L)													818.3227 (232)
Total delivered energy for all uses													18884.3272 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	15049.4209	3.4800	523.7198	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2986.5836	3.4800	103.9331	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	818.3227	13.1900	107.9368	(250)
Additional standing charges			120.0000	(251)
Total energy cost			859.5467	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8507 (257)
SAP value		88.1325
SAP rating (Section 12)		88 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	15049.4209	0.2160	3250.6749	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2986.5836	0.2160	645.1021	(264)
Space and water heating			3895.7770	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	818.3227	0.5190	424.7095	(268)
Total kg/year			4336.0564	(272)
CO2 emissions per m2			11.4300	(273)
EI value			86.3081	
EI rating			86	(274)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band

B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.25) / 0.9090 = 4.106$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.25) / 0.9090 = 0.2549$, stars = 4
Water heating energy efficiency	$3.48 / 0.8636 = 4.030$, stars = 4
Water heating environmental impact	$0.216 / 0.8636 = 0.2501$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (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					7 * 10 = 70.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 70.0000 / (5) = 0.0680 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3180 (18)							
Number of sides sheltered					2 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2703 (21)							
Wind speed	Jan 4.7000	Feb 4.4000	Mar 4.5000	Apr 4.0000	May 4.1000	Jun 3.5000	Jul 3.7000	Aug 3.9000	Sep 3.8000	Oct 4.1000	Nov 4.0000	Dec 4.4000 (22)
Wind factor	1.1750	1.1000	1.1250	1.0000	1.0250	0.8750	0.9250	0.9750	0.9500	1.0250	1.0000	1.1000 (22a)
Adj infilt rate	0.3176	0.2973	0.3041	0.2703	0.2770	0.2365	0.2500	0.2635	0.2568	0.2770	0.2703	0.2973 (22b)
Effective ac	0.5504	0.5442	0.5462	0.5365	0.5384	0.5280	0.5313	0.5347	0.5330	0.5384	0.5365	0.5442 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m2)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 240.6057		(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			18.0000	2403.1800 (32e)					
Internal Ceiling 2			67.3700			18.0000	1212.6600 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 51886.4400 (34)					
Thermal mass parameter (TMP) = Cm / TFA in kJ/m2K							136.7736 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.8414 (36)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 187.0652	Feb 184.9472	Mar 185.6377	Apr 182.3405	May 182.9689	Jun 179.4312	Jul 180.5484	Aug 181.7276	Sep 181.1302	Oct 182.9689	Nov 182.3405	Dec 184.9472 (38)
Heat transfer coeff	445.5123	443.3944	444.0848	440.7877	441.4161	437.8784	438.9955	440.1748	439.5774	441.4161	440.7877	443.3944 (39)
Average = Sum(39)m / 12 =												441.4516 (39)
HLP	Jan 1.1744	Feb 1.1688	Mar 1.1706	Apr 1.1619	May 1.1636	Jun 1.1543	Jul 1.1572	Aug 1.1603	Sep 1.1587	Oct 1.1636	Nov 1.1619	Dec 1.1688 (40)
HLP (average)												1.1637 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Assumed occupancy 3.2351 (42)
Average daily hot water use (litres/day) 111.0336 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy content (annual)	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)
Energy content (annual)	Total = Sum(45)m = 1746.9905 (45)											
Distribution loss (46)m = 0.15 x (45)m	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116 (46)
Water storage loss:												
Store volume	300.0000 (47)											
a) If manufacturer declared loss factor is known (kWh/day):	2.8600 (48)											
Temperature factor from Table 2b	0.5400 (49)											
Enter (49) or (54) in (55)	1.5444 (55)											
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (64)
Total per year (kWh/year) = Sum(64)m =	2584.5925 (64)											
Heat gains from water heating, kWh/month	117.1353	104.0760	111.2644	102.4617	102.3795	94.3111	93.2688	98.6321	97.2946	106.1137	108.7837	115.2350 (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	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	115.8420	102.8899	83.6757	63.3479	47.3533	39.9776	43.1972	56.1494	75.3636	95.6914	111.6860	119.0617 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	775.7584	783.8084	763.5228	720.3371	665.8230	614.5874	580.3589	572.3090	592.5946	635.7802	690.2943	741.5299 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457 (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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039 (71)
Water heating gains (Table 5)	157.4399	154.8750	149.5489	142.3080	137.6069	130.9876	125.3613	132.5701	135.1314	142.6259	151.0885	154.8858 (72)
Total internal gains	1174.3880	1166.9209	1122.0949	1051.3406	976.1308	910.9003	874.2651	886.3761	928.4372	999.4452	1078.4165	1140.8250 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Northeast	26.9200	12.9280	0.5500	0.0000	0.7700	147.3876 (75)		
Southeast	1.0500	40.5720	0.5500	0.0000	0.7700	18.0414 (77)		
Southwest	40.6800	40.5720	0.5500	0.0000	0.7700	698.9738 (79)		
Northwest	4.2000	12.9280	0.5500	0.0000	0.7700	22.9951 (81)		
Northeast	1.5800	20.0673	0.6300	0.7000	1.0000	12.5843 (82)		
Southeast	1.5800	43.0800	0.6300	0.7000	1.0000	27.0155 (82)		
Northwest	1.5800	20.0673	0.6300	0.7000	1.0000	12.5843 (82)		
Horizontal	9.5000	30.0000	0.6300	0.7000	1.0000	113.1165 (82)		

Solar gains 1052.6985 1685.9542 2548.6749 3653.3290 4316.3688 4769.2607 4526.9074 3980.5893 3171.2188 2072.8042 1313.5466 878.3413 (83)
Total gains 2227.0865 2852.8751 3670.7698 4704.6696 5292.4997 5680.1609 5401.1725 4866.9654 4099.6560 3072.2494 2391.9631 2019.1663 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.3513	32.5058	32.4553	32.6981	32.6515	32.9153	32.8315	32.7436	32.7881	32.6515	32.6981	32.5058
alpha	3.1568	3.1671	3.1637	3.1799	3.1768	3.1944	3.1888	3.1829	3.1859	3.1768	3.1799	3.1671
util living area	0.9824	0.9629	0.9072	0.7754	0.5973	0.3808	0.2496	0.2854	0.5619	0.8603	0.9636	0.9866 (86)
MIT	19.4956	19.7281	20.1357	20.5566	20.7959	20.8954	20.9119	20.9098	20.8445	20.4812	19.9152	19.4471 (87)
Th 2	19.9406	19.9450	19.9436	19.9506	19.9492	19.9568	19.9544	19.9519	19.9532	19.9492	19.9506	19.9450 (88)
util rest of house	0.9788	0.9557	0.8894	0.7374	0.5376	0.3074	0.1665	0.1938	0.4786	0.8247	0.9549	0.9838 (89)
MIT 2	17.9324	18.2705	18.8478	19.4208	19.7127	19.8206	19.8296	19.8262	19.7756	19.3390	18.5483	17.8653 (90)
Living area fraction	fLA = Living area / (4) = 0.1573 (91)											
MIT	18.1783	18.4998	19.0504	19.5995	19.8831	19.9897	19.9999	19.9966	19.9437	19.5187	18.7633	18.1141 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.0283	18.3498	18.9004	19.4495	19.7331	19.8397	19.8499	19.8466	19.7937	19.3687	18.6133	17.9641 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9695	0.9408	0.8676	0.7169	0.5245	0.2990	0.1581	0.1844	0.4649	0.8006	0.9397	0.9761	(94)
Useful gains	2159.0930	2684.1189	3184.7113	3372.6604	2775.8844	1698.2156	853.9600	897.4572	1906.1096	2459.6184	2247.8340	1970.8782	(95)
Ext temp.	5.0000	5.5000	7.4000	9.9000	12.9000	15.9000	17.9000	17.8000	15.2000	11.6000	7.9000	5.0000	(96)
Heat loss rate W													
Month fracti	5804.2617	5697.5257	5107.1661	4209.3069	3016.2542	1725.0883	855.9860	900.8800	2019.2954	3429.2221	4722.2987	5748.2092	(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	2712.0055	2025.0094	1430.3064	602.3855	178.8351	0.0000	0.0000	0.0000	0.0000	721.3852	1781.6146	2810.3342	(98)
Space heating per m2												12261.8759	(98)
												(98) / (4) =	32.3225 (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 %)													93.3000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													13142.4179 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2712.0055	2025.0094	1430.3064	602.3855	178.8351	0.0000	0.0000	0.0000	0.0000	721.3852	1781.6146	2810.3342	(98)
Space heating efficiency (main heating system 1)	93.3000	93.3000	93.3000	93.3000	93.3000	0.0000	0.0000	0.0000	0.0000	93.3000	93.3000	93.3000	(210)
Space heating fuel (main heating system)	2906.7583	2170.4280	1533.0186	645.6436	191.6775	0.0000	0.0000	0.0000	0.0000	773.1888	1909.5548	3012.1482	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)
Efficiency of water heater (217)m	89.9432	89.7881	89.3266	88.0415	85.1766	80.8000	80.8000	80.8000	80.8000	88.3277	89.6173	89.9927	(216)
Fuel for water heating, kWh/month	280.4707	247.9926	262.6400	240.0684	244.0650	231.2458	223.3732	243.3364	242.3510	248.0724	257.0633	273.9657	(219)
Water heating fuel used												2994.6446	(219)
Annual totals kWh/year													
Space heating fuel - main system													13142.4179 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: central heating pump													30.0000 (230c)
Total electricity for the above, kWh/year													30.0000 (231)
Electricity for lighting (calculated in Appendix L)													818.3227 (232)
Total delivered energy for all uses													16985.3852 (238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	13142.4179	10.2300	1344.4693	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2994.6446	10.2300	306.3521	(247)
Pumps and fans for heating	30.0000	36.7200	11.0160	(249)
Energy for lighting	818.3227	36.7200	300.4881	(250)
Additional standing charges			103.0000	(251)
Total energy cost			2065.3256	(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	13142.4179	0.2160	2838.7623	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2994.6446	0.2160	646.8432	(264)
Space and water heating			3485.6055	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	818.3227	0.5190	424.7095	(268)
Total kg/year			3925.8850	(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	13142.4179	1.2200	16033.7498	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2994.6446	1.2200	3653.4664	(264)
Space and water heating			19687.2163	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	818.3227	3.0700	2512.2506	(268)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Primary energy kWh/year
Primary energy kWh/m²/year

22291.5669 (272)
58.7610 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 86

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 3.1	-£ 666	-941 kg (24.0%)
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.6	-£ 125	-276 kg (7.0%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar photovoltaic panels	£666	2.48 kg/m ²	B 91 B 89
Total Savings	£666	2.48 kg/m ²	

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

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£312	£312	£0
Mains gas	£1754	£1754	£0
Space heating	£1458	£1458	£0
Water heating	£306	£306	£0
Lighting	£300	£300	£0
Generated (PV)	-£0	-£666	£666
Total cost of fuels	£2066	£1400	£666
Total cost of uses	£2064	£1398	£666
Delivered energy	45 kWh/m ²	40 kWh/m ²	5 kWh/m ²
Carbon dioxide emissions	3.9 tonnes	3.0 tonnes	0.9 tonnes
CO2 emissions per m ²	10 kg/m ²	8 kg/m ²	2 kg/m ²
Primary energy	59 kWh/m ²	44 kWh/m ²	15 kWh/m ²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (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					7 * 10 = 70.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 70.0000 / (5) = 0.0680 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3180 (18)							
Number of sides sheltered					2 (19)							
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.8500 (20)							
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.2703 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.3446	0.3378	0.3311	0.2973	0.2905	0.2568	0.2568	0.2500	0.2703	0.2905	0.3041	0.3176 (22b)
Effective ac	0.5594	0.5571	0.5548	0.5442	0.5422	0.5330	0.5330	0.5313	0.5365	0.5422	0.5462	0.5504 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m2)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 240.6057		(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			18.0000	2403.1800 (32e)					
Internal Ceiling 2			67.3700			18.0000	1212.6600 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 51886.4400 (34)					
Thermal mass parameter (TMP) = Cm / TFA in kJ/m2K							136.7736 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.8414 (36)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 190.1063	Feb 189.3228	Mar 188.5547	Apr 184.9472	May 184.2723	Jun 181.1302	Jul 181.1302	Aug 180.5484	Sep 182.3405	Oct 184.2723	Nov 185.6377	Dec 187.0652 (38)
Heat transfer coeff	448.5535	447.7699	447.0019	443.3944	442.7194	439.5774	439.5774	438.9955	440.7877	442.7194	444.0848	445.5123 (39)
Average = Sum(39)m / 12 =												443.3911 (39)
HLP	Jan 1.1824	Feb 1.1803	Mar 1.1783	Apr 1.1688	May 1.1670	Jun 1.1587	Jul 1.1587	Aug 1.1572	Sep 1.1619	Oct 1.1670	Nov 1.1706	Dec 1.1744 (40)
HLP (average)												1.1688 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Assumed occupancy 3.2351 (42)
Average daily hot water use (litres/day) 111.0336 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369 (44)
Energy content (annual)	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104 (45)
Distribution loss (46)m = 0.15 x (45)m	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.8600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.5444 (55)
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764 (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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492 (64)
Heat gains from water heating, kWh/month	117.1353	104.0760	111.2644	102.4617	102.3795	94.3111	93.2688	98.6321	97.2946	106.1137	108.7837	115.2350 (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	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	115.8420	102.8899	83.6757	63.3479	47.3533	39.9776	43.1972	56.1494	75.3636	95.6914	111.6860	119.0617 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	775.7584	783.8084	763.5228	720.3371	665.8230	614.5874	580.3589	572.3090	592.5946	635.7802	690.2943	741.5299 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457 (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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039 (71)
Water heating gains (Table 5)	157.4399	154.8750	149.5489	142.3080	137.6069	130.9876	125.3613	132.5701	135.1314	142.6259	151.0885	154.8858 (72)
Total internal gains	1174.3880	1166.9209	1122.0949	1051.3406	976.1308	910.9003	874.2651	886.3761	928.4372	999.4452	1078.4165	1140.8250 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	26.9200	11.2829	0.5500	0.0000	0.7700	128.6325 (75)
Southeast	1.0500	36.7938	0.5500	0.0000	0.7700	16.3613 (77)
Southwest	40.6800	36.7938	0.5500	0.0000	0.7700	633.8834 (79)
Northwest	4.2000	11.2829	0.5500	0.0000	0.7700	20.0690 (81)
Northeast	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)
Southeast	1.5800	38.2331	0.6300	0.7000	1.0000	23.9760 (82)
Northwest	1.5800	17.4137	0.6300	0.7000	1.0000	10.9202 (82)
Horizontal	9.5000	26.0000	0.6300	0.7000	1.0000	98.0343 (82)

Solar gains 942.7969 1704.5126 2578.4722 3582.2342 4347.5815 4458.6625 4239.6781 3650.1566 2924.8684 1951.7575 1147.5831 794.7727 (83)
Total gains 2117.1849 2871.4336 3700.5671 4633.5748 5323.7123 5369.5627 5113.9432 4536.5327 3853.3056 2951.2027 2225.9996 1935.5976 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)	32.1320	32.1882	32.2435	32.5058	32.5554	32.7881	32.7881	32.8315	32.6981	32.5554	32.4553	32.3513 (85)
alpha	3.1421	3.1459	3.1496	3.1671	3.1704	3.1859	3.1859	3.1888	3.1799	3.1704	3.1637	3.1568
util living area	0.9864	0.9660	0.9186	0.8125	0.6554	0.4898	0.3674	0.4258	0.6645	0.8961	0.9743	0.9896 (86)
MIT	19.3660	19.6425	20.0302	20.4546	20.7342	20.8626	20.8995	20.8902	20.7767	20.3510	19.7635	19.3150 (87)
Th 2	19.9341	19.9358	19.9374	19.9450	19.9465	19.9532	19.9532	19.9544	19.9506	19.9465	19.9436	19.9406 (88)
util rest of house	0.9837	0.9595	0.9036	0.7806	0.6036	0.4199	0.2843	0.3364	0.5934	0.8700	0.9683	0.9875 (89)
MIT 2	17.7391	18.1399	18.6931	19.2810	19.6375	19.7877	19.8208	19.8161	19.7030	19.1601	18.3246	17.6695 (90)
Living area fraction									fLA = Living area / (4) =			0.1573 (91)
MIT	17.9951	18.3763	18.9035	19.4656	19.8100	19.9568	19.9905	19.9851	19.8720	19.3474	18.5509	17.9283 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8451	18.2263	18.7535	19.3156	19.6600	19.8068	19.8405	19.8351	19.7220	19.1974	18.4009	17.7783 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9760	0.9454	0.8826	0.7588	0.5883	0.4096	0.2751	0.3257	0.5761	0.8467	0.9560	0.9812	(94)
Useful gains	2066.2916	2714.6842	3266.0955	3515.7764	3131.7562	2199.4743	1406.8718	1477.6473	2220.0357	2498.6667	2128.0585	1899.2131	(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													
6075.6862	5967.1094	5477.3280	4618.2399	3524.0614	2288.7844	1424.4690	1507.9834	2478.0871	3806.2417	5018.5696	6049.3218	6049.3218	(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													
2982.9895	2185.6298	1645.1570	793.7737	291.8750	0.0000	0.0000	0.0000	0.0000	0.0000	972.8358	2081.1680	3087.6809	(98)
Space heating												14041.1097	(98)
Space heating per m2												(98) / (4) =	37.0126 (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 %)													93.3000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													15049.4209 (211)
Space heating requirement	2982.9895	2185.6298	1645.1570	793.7737	291.8750	0.0000	0.0000	0.0000	0.0000	972.8358	2081.1680	3087.6809	(98)
Space heating efficiency (main heating system 1)	93.3000	93.3000	93.3000	93.3000	93.3000	0.0000	0.0000	0.0000	0.0000	93.3000	93.3000	93.3000	(210)
Space heating fuel (main heating system)	3197.2021	2342.5828	1763.2980	850.7757	312.8350	0.0000	0.0000	0.0000	0.0000	1042.6964	2230.6195	3309.4115	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)
Efficiency of water heater	90.0226	89.8614	89.5037	88.5719	86.4071	80.8000	80.8000	80.8000	80.8000	88.8582	89.7815	90.0675	(217)
Fuel for water heating, kWh/month	280.2234	247.7903	262.1204	238.6309	240.5891	231.2458	223.3732	243.3364	242.3510	246.5915	256.5933	273.7383	(219)
Water heating fuel used												2986.5836	(219)
Annual totals kWh/year													
Space heating fuel - main system													15049.4209 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
Total electricity for the above, kWh/year													30.0000 (231)
Electricity for lighting (calculated in Appendix L)													818.3227 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394			-1727.2394 (233)
Total delivered energy for all uses													17157.0878 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	15049.4209	3.4800	523.7198	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2986.5836	3.4800	103.9331	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	818.3227	13.1900	107.9368	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			631.7238	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)		0.6252 (257)
SAP value	[(255) x (256)] / [(4) + 45.0] =	91.2780
SAP rating (Section 12)		91 (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	15049.4209	0.2160	3250.6749	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2986.5836	0.2160	645.1021	(264)
Space and water heating			3895.7770	(265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	818.3227	0.5190	424.7095 (268)
Energy saving/generation technologies			
PV Unit			
Total kg/year	-1727.2394	0.5190	-896.4372 (269)
CO2 emissions per m2			3439.6192 (272)
EI value			9.0700 (273)
EI rating			89.1387
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	178.4800 (1b)	x 2.8500 (2b)	= 508.6680 (1b) - (3b)
First floor	133.5100 (1c)	x 2.9400 (2c)	= 392.5194 (1c) - (3c)
Second floor	67.3700 (1d)	x 1.9100 (2d)	= 128.6767 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	379.3600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1029.8641 (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					7 * 10 = 70.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 70.0000 / (5) = 0.0680 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3180 (18)							
Number of sides sheltered					2 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2703 (21)							
Wind speed	Jan 4.7000	Feb 4.4000	Mar 4.5000	Apr 4.0000	May 4.1000	Jun 3.5000	Jul 3.7000	Aug 3.9000	Sep 3.8000	Oct 4.1000	Nov 4.0000	Dec 4.4000 (22)
Wind factor	1.1750	1.1000	1.1250	1.0000	1.0250	0.8750	0.9250	0.9750	0.9500	1.0250	1.0000	1.1000 (22a)
Adj infiltr rate	0.3176	0.2973	0.3041	0.2703	0.2770	0.2365	0.2500	0.2635	0.2568	0.2770	0.2703	0.2973 (22b)
Effective ac	0.5504	0.5442	0.5462	0.5365	0.5384	0.5280	0.5313	0.5347	0.5330	0.5384	0.5365	0.5442 (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					
Glazing (Uw = 1.40)			72.8500	1.3258	96.5814		(27)					
Solid Door			2.0000	1.4000	2.8000		(26)					
Rooflight (Uw = 1.40)			14.2400	1.3258	18.8788		(27a)					
Heat Loss Floor 1			190.3800	0.1500	28.5570	110.0000	20941.8000 (28a)					
External Wall 1	325.2500	71.4700	253.7800	0.2300	58.3694	9.0000	2284.0200 (29a)					
Dormer Cheeks	16.6100	3.3800	13.2300	0.3000	3.9690	9.0000	119.0700 (29a)					
Ashlar Wall	29.6900		29.6900	0.1300	3.8597	9.0000	267.2100 (29a)					
Flat Roof	48.0200	9.5000	38.5200	0.1600	6.1632	9.0000	346.6800 (30)					
Slope Roof	68.2900	4.7400	63.5500	0.1800	11.4390	9.0000	571.9500 (30)					
Dormer Roof	6.9500		6.9500	0.2000	1.3900	9.0000	62.5500 (30)					
Ashlar Ceiling	66.1400		66.1400	0.1300	8.5982	9.0000	595.2600 (30)					
Total net area of external elements Aum(A, m2)			751.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 240.6057		(33)					
Stud			311.0800			9.0000	2799.7200 (32c)					
Block			222.2200			75.0000	16666.5000 (32c)					
Internal Floor 1			133.5100			18.0000	2403.1800 (32d)					
Internal Floor 2			67.3700			18.0000	1212.6600 (32d)					
Internal Ceiling 1			133.5100			18.0000	2403.1800 (32e)					
Internal Ceiling 2			67.3700			18.0000	1212.6600 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 51886.4400 (34)					
Thermal mass parameter (TMP) = Cm / TFA in kJ/m2K							136.7736 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.8414 (36)					
Total fabric heat loss							(33) + (36) = 258.4471 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 187.0652	Feb 184.9472	Mar 185.6377	Apr 182.3405	May 182.9689	Jun 179.4312	Jul 180.5484	Aug 181.7276	Sep 181.1302	Oct 182.9689	Nov 182.3405	Dec 184.9472 (38)
Heat transfer coeff	445.5123	443.3944	444.0848	440.7877	441.4161	437.8784	438.9955	440.1748	439.5774	441.4161	440.7877	443.3944 (39)
Average = Sum(39)m / 12 =												441.4516 (39)
HLP	Jan 1.1744	Feb 1.1688	Mar 1.1706	Apr 1.1619	May 1.1636	Jun 1.1543	Jul 1.1572	Aug 1.1603	Sep 1.1587	Oct 1.1636	Nov 1.1619	Dec 1.1688 (40)
HLP (average)												1.1637 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Assumed occupancy 3.2351 (42)
Average daily hot water use (litres/day) 111.0336 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	122.1369	117.6956	113.2542	108.8129	104.3716	99.9302	99.9302	104.3716	108.8129	113.2542	117.6956	122.1369	(44)
Energy content (annual)	181.1255	158.4136	163.4686	142.5159	136.7474	118.0026	109.3468	125.4770	126.9756	147.9778	161.5294	175.4104	(45)
Distribution loss (46)m = 0.15 x (45)m	27.1688	23.7620	24.5203	21.3774	20.5121	17.7004	16.4020	18.8216	19.0463	22.1967	24.2294	26.3116	(46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.8600 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.5444 (55)
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	(56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)
Heat gains from water heating, kWh/month	117.1353	104.0760	111.2644	102.4617	102.3795	94.3111	93.2688	98.6321	97.2946	106.1137	108.7837	115.2350	(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	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	194.1059	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	115.8420	102.8899	83.6757	63.3479	47.3533	39.9776	43.1972	56.1494	75.3636	95.6914	111.6860	119.0617	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	775.7584	783.8084	763.5228	720.3371	665.8230	614.5874	580.3589	572.3090	592.5946	635.7802	690.2943	741.5299	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	57.6457	(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)	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	-129.4039	(71)
Water heating gains (Table 5)	157.4399	154.8750	149.5489	142.3080	137.6069	130.9876	125.3613	132.5701	135.1314	142.6259	151.0885	154.8858	(72)
Total internal gains	1174.3880	1166.9209	1122.0949	1051.3406	976.1308	910.9003	874.2651	886.3761	928.4372	999.4452	1078.4165	1140.8250	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	26.9200	12.9280	0.5500	0.0000	0.7700	147.3876	(75)
Southeast	1.0500	40.5720	0.5500	0.0000	0.7700	18.0414	(77)
Southwest	40.6800	40.5720	0.5500	0.0000	0.7700	698.9738	(79)
Northwest	4.2000	12.9280	0.5500	0.0000	0.7700	22.9951	(81)
Northeast	1.5800	20.0673	0.6300	0.7000	1.0000	12.5843	(82)
Southeast	1.5800	43.0800	0.6300	0.7000	1.0000	27.0155	(82)
Northwest	1.5800	20.0673	0.6300	0.7000	1.0000	12.5843	(82)
Horizontal	9.5000	30.0000	0.6300	0.7000	1.0000	113.1165	(82)

Solar gains 1052.6985 1685.9542 2548.6749 3653.3290 4316.3688 4769.2607 4526.9074 3980.5893 3171.2188 2072.8042 1313.5466 878.3413 (83)
Total gains 2227.0865 2852.8751 3670.7698 4704.6696 5292.4997 5680.1609 5401.1725 4866.9654 4099.6560 3072.2494 2391.9631 2019.1663 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)	32.3513	32.5058	32.4553	32.6981	32.6515	32.9153	32.8315	32.7436	32.7881	32.6515	32.6981	32.5058	21.0000 (85)
alpha	3.1568	3.1671	3.1637	3.1799	3.1768	3.1944	3.1888	3.1829	3.1859	3.1768	3.1799	3.1671	
util living area	0.9824	0.9629	0.9072	0.7754	0.5973	0.3808	0.2496	0.2854	0.5619	0.8603	0.9636	0.9866	(86)
MIT	19.4956	19.7281	20.1357	20.5566	20.7959	20.8954	20.9119	20.9098	20.8445	20.4812	19.9152	19.4471	(87)
Th 2	19.9406	19.9450	19.9436	19.9506	19.9492	19.9568	19.9544	19.9519	19.9532	19.9492	19.9506	19.9450	(88)
util rest of house	0.9788	0.9557	0.8894	0.7374	0.5376	0.3074	0.1665	0.1938	0.4786	0.8247	0.9549	0.9838	(89)
MIT 2	17.9324	18.2705	18.8478	19.4208	19.7127	19.8206	19.8296	19.8262	19.7756	19.3390	18.5483	17.8653	(90)
Living area fraction									fLA = Living area / (4) =				0.1573 (91)
MIT	18.1783	18.4998	19.0504	19.5995	19.8831	19.9897	19.9999	19.9966	19.9437	19.5187	18.7633	18.1141	(92)
Temperature adjustment													-0.1500
adjusted MIT	18.0283	18.3498	18.9004	19.4495	19.7331	19.8397	19.8499	19.8466	19.7937	19.3687	18.6133	17.9641	(93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9695	0.9408	0.8676	0.7169	0.5245	0.2990	0.1581	0.1844	0.4649	0.8006	0.9397	0.9761	(94)
Useful gains	2159.0930	2684.1189	3184.7113	3372.6604	2775.8844	1698.2156	853.9600	897.4572	1906.1096	2459.6184	2247.8340	1970.8782	(95)
Ext temp.	5.0000	5.5000	7.4000	9.9000	12.9000	15.9000	17.9000	17.8000	15.2000	11.6000	7.9000	5.0000	(96)
Heat loss rate W													
Month fracti	5804.2617	5697.5257	5107.1661	4209.3069	3016.2542	1725.0883	855.9860	900.8800	2019.2954	3429.2221	4722.2987	5748.2092	(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	2712.0055	2025.0094	1430.3064	602.3855	178.8351	0.0000	0.0000	0.0000	0.0000	721.3852	1781.6146	2810.3342	(98)
Space heating per m2												12261.8759	(98)
												(98) / (4) =	32.3225 (99)

8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.3000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													13142.4179 (211)
Space heating requirement	2712.0055	2025.0094	1430.3064	602.3855	178.8351	0.0000	0.0000	0.0000	0.0000	721.3852	1781.6146	2810.3342	(98)
Space heating efficiency (main heating system 1)	93.3000	93.3000	93.3000	93.3000	93.3000	0.0000	0.0000	0.0000	0.0000	93.3000	93.3000	93.3000	(210)
Space heating fuel (main heating system)	2906.7583	2170.4280	1533.0186	645.6436	191.6775	0.0000	0.0000	0.0000	0.0000	773.1888	1909.5548	3012.1482	(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	252.2643	222.6680	234.6074	211.3599	207.8862	186.8466	180.4856	196.6158	195.8196	219.1166	230.3734	246.5492	(64)
Efficiency of water heater	89.9432	89.7881	89.3266	88.0415	85.1766	80.8000	80.8000	80.8000	80.8000	88.3277	89.6173	89.9927	(217)
Fuel for water heating, kWh/month	280.4707	247.9926	262.6400	240.0684	244.0650	231.2458	223.3732	243.3364	242.3510	248.0724	257.0633	273.9657	(219)
Water heating fuel used													2994.6446 (219)
Annual totals kWh/year													
Space heating fuel - main system													13142.4179 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
Total electricity for the above, kWh/year													30.0000 (231)
Electricity for lighting (calculated in Appendix L)													818.3227 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1133 * 0.80) =										-1812.7461			-1812.7461 (233)
Total delivered energy for all uses													15172.6390 (238)

10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	13142.4179	10.2300	1344.4693	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2994.6446	10.2300	306.3521	(247)
Pumps and fans for heating	30.0000	36.7200	11.0160	(249)
Energy for lighting	818.3227	36.7200	300.4881	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1812.7461	36.7200	-665.6404	(252)
Total energy cost			1399.6852	(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	13142.4179	0.2160	2838.7623	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2994.6446	0.2160	646.8432	(264)
Space and water heating			3485.6055	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	818.3227	0.5190	424.7095	(268)
Energy saving/generation technologies				
PV Unit	-1812.7461	0.5190	-940.8152	(269)
Total kg/year			2985.0697	(272)

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	13142.4179	1.2200	16033.7498 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2994.6446	1.2200	3653.4664 (264)
Space and water heating			19687.2163 (265)
Pumps and fans	30.0000	3.0700	92.1000 (267)
Energy for lighting	818.3227	3.0700	2512.2506 (268)
Energy saving/generation technologies			
PV Unit	-1812.7461	3.0700	-5565.1306 (269)
Primary energy kWh/year			16726.4362 (272)
Primary energy kWh/m2/year			44.0912 (273)