

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	BD23 6RR Plot 49			<b>Issued on Date</b>	20/07/2022
<b>Assessment Reference</b>	001	<b>Prop Type Ref</b>	Type H		
<b>Property</b>	Plot 49, Phase 5, Shires Lane, Embsay, Skipton, BD23 6RR				
<b>SAP Rating</b>	90 B	<b>DER</b>	9.89	<b>TER</b>	13.61
<b>Environmental</b>	90 B	<b>% DER&lt;TER</b>	27.35		
<b>CO<sub>2</sub> Emissions (t/year)</b>	2.44	<b>DFEE</b>	48.39	<b>TFEE</b>	53.25
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	9.14		
<b>Assessor Details</b>	Mr. Jake Eaton, Jake Eaton, Tel: 01400283471, jake@aeratech.co.uk			<b>Assessor ID</b>	P711-0001
<b>Client</b>					

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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 241 m<sup>2</sup>

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

#### 1a TER and DER

Fuel for main heating: Mains gas  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.61 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 9.89 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 48.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.61 (max. 2.00)	1.80 (max. 3.30)	OK

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 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 rated a

Efficiency: 89%  
Minimum: 88% OK

Secondary heating system: Room heaters - Wood Logs

#### Closed room heater

Efficiency: 65%  
Minimum: 65% OK

#### 5 Cylinder insulation

Hot water storage: Nominal cylinder loss: 2.27 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

Continuous extract system (decentralised)  
Specific fan power: 0.1600 0.1600  
Maximum 0.7 OK

#### 9 Summertime temperature

Overheating risk (North East England): Not significant OK

#### Based on:

Overshading: Average  
Windows facing North East: 12.81 m<sup>2</sup>, No overhang  
Windows facing South East: 9.33 m<sup>2</sup>, No overhang  
Windows facing South West: 13.35 m<sup>2</sup>, No overhang  
Windows facing North West: 5.12 m<sup>2</sup>, No overhang  
Air change rate: 2.50 ach  
Blinds/curtains: Light-coloured curtain or roller blind, closed 50% of daylight hours

#### 10 Key features

External wall U-value: 0.12 W/m<sup>2</sup>K  
Roof U-value: 0.12 W/m<sup>2</sup>K  
Secondary heating (wood logs)  
Secondary heating fuel: wood logs  
Photovoltaic array: 2.00 kW

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= {6a}+{6b}+{7a}+{7b}+{7c} =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (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) = 0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised	0.5000 (23a)											
If mechanical ventilation:												
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26)
Opening Type 2 (Uw = 1.60)			40.6100	1.5038	61.0677		(27)
Opening Type 3 (Uw = 1.60)			3.0100	1.5038	4.5263		(27a)
Heat Loss Floor 1			103.7000	0.1300	13.4810	75.0000	7777.5000 (28a)
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820	110.0000	21439.0000 (29a)
Sheltered Room in Roof Wall	25.0000		25.0000	0.1200	3.0000	9.0000	225.0000 (29a)
External Roof 1	70.6600	3.0100	67.6500	0.1700	11.5005	0.0000	0.0000 (30)
External Roof 2	10.7800		10.7800	0.1300	1.4014	9.0000	97.0200 (30)
Sheltered Plane Roof	30.2900		30.2900	0.1200	3.6348	9.0000	272.6100 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	137.5097			(33)
Internal Wall 1			87.3200			75.0000	6549.0000 (32c)
Internal Wall 2			204.5100			9.0000	1840.5900 (32c)
Internal Floor 1			83.7900			18.0000	1508.2200 (32d)
Internal Floor 2			53.5000			18.0000	963.0000 (32d)
Internal Ceiling 1			83.7900			18.0000	1508.2200 (32e)
Internal Ceiling 2			53.5000			18.0000	963.0000 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	43143.1600 (34)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K				179.0247 (35)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				35.3473 (36)			
Total fabric heat loss			(33) + (36) =	172.8570 (37)			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	103.2741	102.2209	101.1677	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233 (38)
Heat transfer coeff	276.1310	275.0779	274.0247	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803 (39)
Average = Sum(39)m / 12 =												272.7547 (39)
HLP	1.1458	1.1414	1.1371	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286 (40)
HLP (average)	1.1318 (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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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed occupancy												3.0552 (42)
Average daily hot water use (litres/day)												106.7614 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Energy content (annual)	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Distribution loss (46)m = 0.15 x (45)m												1679.7726 (45)
Temperature factor from Table 2a	26.1235	22.8478	23.5768	20.5549	19.7229	17.0193	15.7709	18.0974	18.3135	21.3426	23.2971	25.2992 (46)
Water storage loss:												
Store volume												300.0000 (47)
b) If manufacturer declared loss factor is not known:												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103 (51)
Volume factor from Table 2a												0.7368 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												1.2281 (55)
Total storage loss	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (56)
If cylinder contains dedicated solar storage	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (64)
Total per year (kWh/year) = Sum(64)m =												2401.9097 (64)
Heat gains from water heating, kWh/month	106.9728	94.9633	101.3277	93.0463	92.7848	85.2092	84.0246	89.1816	88.0779	96.3752	99.1250	105.1456 (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	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.0833	32.9370	26.7862	20.2789	15.1587	12.7976	13.8283	17.9745	24.1253	30.6327	35.7528	38.1139 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	408.5062	412.7452	402.0630	379.3219	350.6154	323.6352	305.6109	301.3718	312.0540	334.7951	363.5017	390.4818 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761 (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)	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)	143.7806	141.3145	136.1932	129.2309	124.7107	118.3461	112.9363	119.8677	122.3304	129.5366	137.6736	141.3248 (72)
Total internal gains	661.1983	658.8249	636.8707	600.6600	562.3130	526.6072	504.2037	511.0423	530.3381	566.7927	608.7564	641.7488 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W						
Northeast	12.8100	11.2829	0.7600	0.7000	0.7700	53.2864 (75)						
Southeast	9.3300	36.7938	0.7600	0.7000	0.7700	126.5615 (77)						
Southwest	13.3500	36.7938	0.7600	0.7000	0.7700	181.0928 (79)						
Northwest	5.1200	11.2829	0.7600	0.7000	0.7700	21.2979 (81)						
Northeast	1.7200	18.0708	0.7600	0.7000	1.0000	14.8820 (82)						
Southwest	1.2900	34.0172	0.7600	0.7000	1.0000	21.0108 (82)						
Solar gains	418.1314	748.0231	1116.2501	1534.8397	1854.9473	1900.5422	1807.8221	1560.4653	1260.1155	851.9603	507.3985	353.5497 (83)
Total gains	1079.3297	1406.8481	1753.1207	2135.4997	2417.2603	2427.1494	2312.0258	2071.5076	1790.4535	1418.7530	1116.1548	995.2984 (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	43.4004	43.5666	43.7341	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628
alpha	3.8934	3.9044	3.9156	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375
util living area	0.9973	0.9922	0.9769	0.9275	0.8151	0.6492	0.4982	0.5681	0.8158	0.9659	0.9942	0.9981 (86)
MIT	19.5971	19.7855	20.0764	20.4350	20.7196	20.8689	20.9143	20.9032	20.7737	20.3790	19.9197	19.5769 (87)
Th 2	19.9636	19.9671	19.9707	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775 (88)
util rest of house	0.9966	0.9902	0.9708	0.9081	0.7682	0.5671	0.3909	0.4567	0.7500	0.9534	0.9924	0.9976 (89)
MIT 2	18.0665	18.3439	18.7681	19.2814	19.6581	19.8292	19.8688	19.8620	19.7351	19.2124	18.5485	18.0472 (90)
Living area fraction												fLA = Living area / (4) =
MIT	18.1985	18.4682	18.8810	19.3809	19.7497	19.9188	19.9590	19.9518	19.8247	19.3130	18.6668	18.1792 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0485	18.3182	18.7310	19.2309	19.5997	19.7688	19.8090	19.8018	19.6747	19.1630	18.5168	18.0292 (93)

#### 8. Space heating requirement



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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9946	0.9856	0.9607	0.8902	0.7480	0.5488	0.3724	0.4361	0.7265	0.9392	0.9885	0.9961	(94)
Useful gains	1073.5463	1386.5201	1684.1594	1901.0775	1808.1317	1331.9522	860.9530	903.3918	1300.6912	1332.5324	1103.3491	991.3933	(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	3796.3920	3691.0614	3351.5882	2809.7972	2148.5641	1405.8249	872.7745	925.2275	1516.1983	2328.9763	3105.1307	3761.2573	(97)
Month fractl	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	2025.7972	1548.6517	1240.5670	654.2782	253.2817	0.0000	0.0000	0.0000	0.0000	741.3543	1441.2827	2060.7788	(98)
Space heating												9965.9916	(98)
Space heating per m2												41.3544	(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)													0.1000	(201)
Fraction of space heat from main system(s)													0.9000	(202)
Efficiency of main space heating system 1 (in %)													89.0000	(206)
Efficiency of secondary/supplementary heating system, %													65.0000	(208)
Space heating requirement													10077.9691	(211)
Space heating requirement	2025.7972	1548.6517	1240.5670	654.2782	253.2817	0.0000	0.0000	0.0000	0.0000	741.3543	1441.2827	2060.7788	(98)	
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)	
Space heating fuel (main heating system)	2048.5590	1566.0523	1254.5060	661.6297	256.1276	0.0000	0.0000	0.0000	0.0000	749.6841	1457.4769	2083.9336	(211)	
Water heating requirement	311.6611	238.2541	190.8565	100.6582	38.9664	0.0000	0.0000	0.0000	0.0000	114.0545	221.7358	317.0429	(215)	
Water heating requirement	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934	(64)	
Efficiency of water heater (217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(216)	
Fuel for water heating, kWh/month	264.5940	233.3879	245.5181	220.6586	216.6495	194.1753	187.0468	204.4734	203.8694	228.7824	241.2000	258.4196	(219)	
Water heating fuel used												2698.7749	(219)	
Annual totals kWh/year														
Space heating fuel - main system													10077.9691	(211)
Space heating fuel - secondary													1533.2295	(215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 12.1440, total flow = 66.0000, SFP = 0.1840)														
mechanical ventilation fans (SFP = 0.1840)													134.8557	(230a)
central heating pump													30.0000	(230c)
main heating flue fan													45.0000	(230e)
Total electricity for the above, kWh/year													209.8557	(231)
Electricity for lighting (calculated in Appendix L)													654.9022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 2.00 * 1029 * 1.00) =										-1646.6987			-1646.6987	(233)
Total delivered energy for all uses													13528.0326	(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	10077.9691	0.2160	2176.8413	(261)
Space heating - secondary	1533.2295	0.0190	29.1314	(263)
Water heating (other fuel)	2698.7749	0.2160	582.9354	(264)
Space and water heating			2788.9081	(265)
Pumps and fans	209.8557	0.5190	108.9151	(267)
Energy for lighting	654.9022	0.5190	339.8942	(268)
Energy saving/generation technologies				
PV Unit	-1646.6987	0.5190	-854.6366	(269)
Total CO2, kg/year			2383.0807	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.8900	(273)

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

DER		9.8900	ZC1
Total Floor Area		240.9900	TFA
Assumed number of occupants		3.0552	N
CO2 emission factor in Table 12 for electricity displaced from grid		0.5190	EF
CO2 emissions from appliances, equation (L14)		10.0449	ZC2
CO2 emissions from cooking, equation (L16)		0.7981	ZC3
Total CO2 emissions		20.7330	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m <sup>2</sup> /year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		20.7330	ZC8

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				40.0000 / (5) =	0.0666 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3166 (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) =		0.2691 (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 infiltr rate												
Effective ac	0.3431	0.3364	0.3296	0.2960	0.2893	0.2556	0.2556	0.2489	0.2691	0.2893	0.3027	0.3162 (22b)
	0.5589	0.5566	0.5543	0.5438	0.5418	0.5327	0.5327	0.5310	0.5362	0.5418	0.5458	0.5500 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			40.6100	1.3258	53.8390		(27)
TER Room Window (Uw = 1.70)			3.0100	1.5918	4.7912		(27a)
Heat Loss Floor 1			103.7000	0.1300	13.4810		(28a)
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820		(29a)
Sheltered Room in Roof Wall	25.0000		25.0000	0.1800	4.5000		(29a)
External Roof 1	70.6600	3.0100	67.6500	0.1300	8.7945		(30)
External Roof 2	10.7800		10.7800	0.1300	1.4014		(30)
Sheltered Plane Roof	30.2900		30.2900	0.1300	3.9377		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	127.9468	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.4450 (36)  
 Total fabric heat loss (33) + (36) = 150.3918 (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
(38)m	110.7917	110.3386	109.8944	107.8084	107.4181	105.6012	105.6012	105.2648	106.3011	107.4181	108.2077	109.0331 (38)
Heat transfer coeff	261.1835	260.7304	260.2863	258.2002	257.8099	255.9930	255.9930	255.6566	256.6929	257.8099	258.5995	259.4249 (39)
Average = Sum(39)m / 12 =												258.1983 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0838	1.0819	1.0801	1.0714	1.0698	1.0623	1.0623	1.0609	1.0652	1.0698	1.0731	1.0765 (40)
HLP (average)												1.0714 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0552 (42)  
 Average daily hot water use (litres/day) 106.7614 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Energy conte	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Energy content (annual)												Total = Sum(45)m = 1679.7726 (45)
Distribution loss (46)m = 0.15 x (45)m												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	26.1235	22.8478	23.5768	20.5549	19.7229	17.0193	15.7709	18.0974	18.3135	21.3426	23.2971	25.2992 (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												
	232.7853	205.2734	215.8077	193.7700	190.1147	170.1998	163.7683	179.2779	178.8276	200.9130	212.0518	227.2901 (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												
	232.7853	205.2734	215.8077	193.7700	190.1147	170.1998	163.7683	179.2779	178.8276	200.9130	212.0518	227.2901 (64)
												Total per year (kWh/year) = Sum(64)m = 2370.0796 (64)
Heat gains from water heating, kWh/month												
	104.8101	93.0099	99.1650	90.9533	90.6221	83.1163	81.8619	87.0189	85.9850	94.2125	97.0320	102.9829 (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	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	37.0833	32.9370	26.7862	20.2789	15.1587	12.7976	13.8283	17.9745	24.1253	30.6327	35.7528	38.1139 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	408.5062	412.7452	402.0630	379.3219	350.6154	323.6352	305.6109	301.3718	312.0540	334.7951	363.5017	390.4818 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761 (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)												
	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)												
	140.8738	138.4076	133.2863	126.3241	121.8039	115.4392	110.0295	116.9609	119.4236	126.6297	134.7667	138.4179 (72)
Total internal gains												
	658.2915	655.9181	633.9638	597.7531	559.4062	523.7003	501.2969	508.1355	527.4312	563.8858	605.8495	638.8419 (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	12.8100	11.2829	0.6300	0.7000	0.7700	44.1716 (75)						
Southeast	9.3300	36.7938	0.6300	0.7000	0.7700	104.9128 (77)						
Southwest	13.3500	36.7938	0.6300	0.7000	0.7700	150.1164 (79)						
Northwest	5.1200	11.2829	0.6300	0.7000	0.7700	17.6549 (81)						
Northeast	1.7200	18.0708	0.6300	0.7000	1.0000	12.3364 (82)						
Southwest	1.2900	34.0172	0.6300	0.7000	1.0000	17.4168 (82)						
Solar gains	346.6089	620.0718	925.3125	1272.3013	1537.6537	1575.4495	1498.5893	1293.5436	1044.5694	706.2303	420.6066	293.0741 (83)
Total gains	1004.9004	1275.9899	1559.2764	1870.0544	2097.0599	2099.1498	1999.8862	1801.6791	1572.0006	1270.1161	1026.4561	931.9160 (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	64.0753	64.1867	64.2962	64.8157	64.9138	65.3745	65.3745	65.4605	65.1963	64.9138	64.7156	64.5097	
alpha	5.2717	5.2791	5.2864	5.3210	5.3276	5.3583	5.3583	5.3640	5.3464	5.3276	5.3144	5.3006	
util living area	0.9997	0.9987	0.9945	0.9728	0.8925	0.7232	0.5516	0.6281	0.8881	0.9901	0.9991	0.9998 (86)	
MIT	19.6757	19.8464	20.1223	20.4840	20.7920	20.9524	20.9908	20.9824	20.8515	20.4369	19.9846	19.6465 (87)	
Th 2	20.0141	20.0156	20.0171	20.0242	20.0256	20.0318	20.0318	20.0329	20.0294	20.0256	20.0229	20.0201 (88)	
util rest of house	0.9995	0.9982	0.9924	0.9619	0.8516	0.6359	0.4363	0.5083	0.8285	0.9847	0.9987	0.9997 (89)	
MIT 2	18.2232	18.4740	18.8777	19.4026	19.8167	19.9995	20.0283	20.0253	19.9021	19.3424	18.6817	18.1847 (90)	
Living area fraction													
	fLA = Living area / (4) = 0.0863 (91)												
MIT	18.3485	18.5924	18.9851	19.4959	19.9008	20.0817	20.1113	20.1079	19.9840	19.4369	18.7941	18.3108 (92)	
Temperature adjustment													
adjusted MIT	18.3485	18.5924	18.9851	19.4959	19.9008	20.0817	20.1113	20.1079	19.9840	19.4369	18.7941	18.3108 (93)	

#### 8. Space heating requirement

Utilisation	0.9992	0.9972	0.9892	0.9541	0.8454	0.6407	0.4460	0.5181	0.8251	0.9798	0.9979	0.9995 (94)
Useful gains	1004.1093	1272.3955	1542.3932	1784.1505	1772.8130	1345.0092	892.0130	933.3706	1297.0745	1244.4854	1024.2787	931.4236 (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												
	3669.2285	3570.0292	3249.6875	2735.8685	2114.2599	1403.2691	898.8711	947.9521	1510.3752	2278.2330	3024.0957	3660.6932 (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												
	1982.8487	1544.0098	1270.2270	685.2369	254.0365	0.0000	0.0000	0.0000	0.0000	769.1082	1439.8682	2030.5766 (98)
Space heating												9975.9119 (98)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2

(98) / (4) = 41.3955 (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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													10669.4245 (211)
Space heating requirement	1982.8487	1544.0098	1270.2270	685.2369	254.0365	0.0000	0.0000	0.0000	0.0000	769.1082	1439.8682	2030.5766	(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)	2120.6937	1651.3474	1358.5315	732.8737	271.6968	0.0000	0.0000	0.0000	0.0000	822.5756	1539.9660	2171.7397	(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	232.7853	205.2734	215.8077	193.7700	190.1147	170.1998	163.7683	179.2779	178.8276	200.9130	212.0518	227.2901	(64)
Efficiency of water heater (217)m	89.2428	89.0981	88.7714	87.9018	85.5878	79.8000	79.8000	79.8000	79.8000	88.0545	88.9687	89.2947	(216)
Fuel for water heating, kWh/month	260.8450	230.3904	243.1050	220.4391	222.1283	213.2830	205.2234	224.6590	224.0947	228.1688	238.3444	254.5392	(219)
Water heating fuel used													2765.2203 (219)
Annual totals kWh/year													
Space heating fuel - main system													10669.4245 (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)													654.9022 (232)
Total delivered energy for all uses													14164.5469 (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	10669.4245	0.2160	2304.5957	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2765.2203	0.2160	597.2876	(264)
Space and water heating			2901.8833	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	654.9022	0.5190	339.8942	(268)
Total CO2, kg/m2/year			3280.7025	(272)
Emissions per m2 for space and water heating			12.0415	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.4104	(272b)
Emissions per m2 for pumps and fans			0.1615	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0415 * 1.00) + 1.4104 + 0.1615, rounded to 2 d.p.			13.6100	(273)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0666 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.3166 (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) =	0.2691 (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 infiltr rate												
Effective ac	0.3431	0.3364	0.3296	0.2960	0.2893	0.2556	0.2556	0.2489	0.2691	0.2893	0.3027	0.3162 (22b)
	0.5589	0.5566	0.5543	0.5438	0.5418	0.5327	0.5327	0.5310	0.5362	0.5418	0.5458	0.5500 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26)
Opening Type 2 (Uw = 1.60)			40.6100	1.5038	61.0677		(27)
Opening Type 3 (Uw = 1.60)			3.0100	1.5038	4.5263		(27a)
Heat Loss Floor 1			103.7000	0.1300	13.4810	75.0000	7777.5000 (28a)
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820	110.0000	21439.0000 (29a)
Sheltered Room in Roof Wall	25.0000		25.0000	0.1200	3.0000	9.0000	225.0000 (29a)
External Roof 1	70.6600	3.0100	67.6500	0.1700	11.5005	0.0000	0.0000 (30)
External Roof 2	10.7800		10.7800	0.1300	1.4014	9.0000	97.0200 (30)
Sheltered Plane Roof	30.2900		30.2900	0.1200	3.6348	9.0000	272.6100 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	137.5097		(33)
Internal Wall 1			87.3200			75.0000	6549.0000 (32c)
Internal Wall 2			204.5100			9.0000	1840.5900 (32c)
Internal Floor 1			83.7900			18.0000	1508.2200 (32d)
Internal Floor 2			53.5000			18.0000	963.0000 (32d)
Internal Ceiling 1			83.7900			9.0000	754.1100 (32e)
Internal Ceiling 2			53.5000			9.0000	481.5000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	41907.5500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							173.8975 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							35.3473 (36)
Total fabric heat loss						(33) + (36) =	172.8570 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	110.7917	110.3386	109.8944	107.8084	107.4181	105.6012	105.6012	105.2648	106.3011	107.4181	108.2077	109.0331 (38)
Heat transfer coeff	283.6487	283.1956	282.7514	280.6654	280.2751	278.4582	278.4582	278.1218	279.1580	280.2751	281.0646	281.8901 (39)
Average = Sum(39)m / 12 =												280.6635 (39)
HLP	1.1770	1.1751	1.1733	1.1646	1.1630	1.1555	1.1555	1.1541	1.1584	1.1630	1.1663	1.1697 (40)
HLP (average)												1.1646 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0552 (42)
Average daily hot water use (litres/day)	106.7614 (43)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
Energy content (annual)	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Distribution loss (46)m = 0.15 x (45)m	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Total												1679.7726 (45)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
If cylinder contains dedicated solar storage												
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 (57)
Heat gains from water heating, kWh/month	37.0083	32.3677	33.4005	29.1194	27.9407	24.1107	22.3421	25.6379	25.9441	30.2354	33.0043	35.8405 (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	37.0833	32.9370	26.7862	20.2789	15.1587	12.7976	13.8283	17.9745	24.1253	30.6327	35.7528	38.1139 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	408.5062	412.7452	402.0630	379.3219	350.6154	323.6352	305.6109	301.3718	312.0540	334.7951	363.5017	390.4818 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761 (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)	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)	49.7423	48.1662	44.8932	40.4436	37.5548	33.4871	30.0298	34.4596	36.0335	40.6390	45.8393	48.1727 (72)
Total internal gains	564.1600	562.6766	542.5706	508.8726	472.1571	438.7482	418.2971	422.6342	441.0411	474.8950	513.9221	545.5967 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	12.8100	11.2829	0.7600	0.7000	0.7700	53.2864 (75)						
Southeast	9.3300	36.7938	0.7600	0.7000	0.7700	126.5615 (77)						
Southwest	13.3500	36.7938	0.7600	0.7000	0.7700	181.0928 (79)						
Northwest	5.1200	11.2829	0.7600	0.7000	0.7700	21.2979 (81)						
Northeast	1.7200	18.0708	0.7600	0.7000	1.0000	14.8820 (82)						
Southwest	1.2900	34.0172	0.7600	0.7000	1.0000	21.0108 (82)						
Solar gains	418.1314	748.0231	1116.2501	1534.8397	1854.9473	1900.5422	1807.8221	1560.4653	1260.1155	851.9603	507.3985	353.5497 (83)
Total gains	982.2913	1310.6998	1658.8207	2043.7123	2327.1044	2339.2904	2226.1192	1983.0995	1701.1566	1326.8554	1021.3205	899.1464 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (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)												
tau	41.0402	41.1058	41.1704	41.4764	41.5341	41.8051	41.8051	41.8557	41.7003	41.5341	41.4175	41.2962
alpha	3.7360	3.7404	3.7447	3.7651	3.7689	3.7870	3.7870	3.7904	3.7800	3.7689	3.7612	3.7531
util living area	0.9978	0.9933	0.9796	0.9354	0.8326	0.6729	0.5230	0.5956	0.8369	0.9713	0.9952	0.9984 (86)
MIT	19.0844	19.3382	19.7369	20.2409	20.6577	20.8933	20.9688	20.9496	20.7426	20.1680	19.5224	19.0395 (87)
Th 2	19.9384	19.9399	19.9414	19.9484	19.9497	19.9558	19.9558	19.9569	19.9534	19.9497	19.9471	19.9443 (88)
util rest of house	0.9972	0.9915	0.9742	0.9178	0.7878	0.5900	0.4105	0.4803	0.7746	0.9605	0.9938	0.9980 (89)
MIT 2	18.1761	18.4301	18.8265	19.3218	19.7046	19.8988	19.9452	19.9380	19.7914	19.2610	18.6200	18.1357 (90)
Living area fraction												
MIT	18.2544	18.5085	18.9051	19.4011	19.7869	19.9846	20.0335	20.0253	19.8735	19.3393	18.6979	18.2136 (92)
Temperature adjustment												
adjusted MIT	18.2544	18.5085	18.9051	19.4011	19.7869	19.9846	20.0335	20.0253	19.8735	19.3393	18.6979	18.2136 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9959	0.9882	0.9671	0.9064	0.7798	0.5925	0.4193	0.4884	0.7689	0.9519	0.9912	0.9970 (94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	3958.1496	3853.8555	3507.5510	2947.2901	2266.5479	1499.3867	956.0972	1008.2738	1611.7126	2449.4033	3259.7468	3950.3075 (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	2217.0536	1719.3522	1416.0129	788.3067	336.2507	0.0000	0.0000	0.0000	0.0000	882.6110	1618.1127	2272.0644 (98)
Space heating												11249.7641 (98)
Space heating per m2												(98) / (4) = 46.6815 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2617.5072	2060.5908	2113.7253	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8223	0.8836	0.8433	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2152.4926	1820.7766	1782.5371	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	2842.0282	2708.5262	2435.5823	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh						1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	496.4656	660.4856	485.8656	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												1642.8169 (104)
Intermittency factor (Table 10b)												1.0000 (105)
FC = cooled area / (4) =						0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												0.0000 (107)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	124.1164	165.1214	121.4664	0.0000	0.0000	0.0000	410.7042 (107)
Space cooling per m2												1.7042 (108)
Energy for space heating												46.6815 (99)
Energy for space cooling												1.7042 (108)
Total												48.3857 (109)
Dwelling Fabric Energy Efficiency (DPEE)												48.4 (109)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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				4 * 10 =	40.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0666 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate				0.3166 (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) =		0.2691 (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												
Effective ac	0.3431	0.3364	0.3296	0.2960	0.2893	0.2556	0.2556	0.2489	0.2691	0.2893	0.3027	0.3162 (22b)
	0.5589	0.5566	0.5543	0.5438	0.5418	0.5327	0.5327	0.5310	0.5362	0.5418	0.5458	0.5500 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			40.6100	1.3258	53.8390		(27)					
TER Room Window (Uw = 1.70)			3.0100	1.5918	4.7912		(27a)					
Heat Loss Floor 1			103.7000	0.1300	13.4810		(28a)					
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820		(29a)					
Sheltered Room in Roof Wall	25.0000		25.0000	0.1800	4.5000		(29a)					
External Roof 1	70.6600	3.0100	67.6500	0.1300	8.7945		(30)					
External Roof 2	10.7800		10.7800	0.1300	1.4014		(30)					
Sheltered Plane Roof	30.2900		30.2900	0.1300	3.9377		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	127.9468	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.4450 (36)					
Total fabric heat loss						(33) + (36) =	150.3918 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 110.7917	Feb 110.3386	Mar 109.8944	Apr 107.8084	May 107.4181	Jun 105.6012	Jul 105.6012	Aug 105.2648	Sep 106.3011	Oct 107.4181	Nov 108.2077	Dec 109.0331 (38)
Heat transfer coeff	261.1835	260.7304	260.2863	258.2002	257.8099	255.9930	255.9930	255.6566	256.6929	257.8099	258.5995	259.4249 (39)
Average = Sum(39)m / 12 =												258.1983 (39)
HLP	Jan 1.0838	Feb 1.0819	Mar 1.0801	Apr 1.0714	May 1.0698	Jun 1.0623	Jul 1.0623	Aug 1.0609	Sep 1.0652	Oct 1.0698	Nov 1.0731	Dec 1.0765 (40)
HLP (average)												1.0714 (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												3.0552 (42)
Average daily hot water use (litres/day)												106.7614 (43)
Daily hot water use	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Energy conte	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Energy content (annual)												Total = Sum(45)m = 1679.7726 (45)
Distribution loss (46)m = 0.15 x (45)m												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	37.0083	32.3677	33.4005	29.1194	27.9407	24.1107	22.3421	25.6379	25.9441	30.2354	33.0043	35.8405 (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	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608	152.7608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.0833	32.9370	26.7862	20.2789	15.1587	12.7976	13.8283	17.9745	24.1253	30.6327	35.7528	38.1139 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	408.5062	412.7452	402.0630	379.3219	350.6154	323.6352	305.6109	301.3718	312.0540	334.7951	363.5017	390.4818 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761	38.2761 (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)	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)	49.7423	48.1662	44.8932	40.4436	37.5548	33.4871	30.0298	34.4596	36.0335	40.6390	45.8393	48.1727 (72)
Total internal gains	564.1600	562.6766	542.5706	508.8726	472.1571	438.7482	418.2971	422.6342	441.0411	474.8950	513.9221	545.5967 (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	12.8100	11.2829	0.6300	0.7000	0.7700	44.1716 (75)
Southeast	9.3300	36.7938	0.6300	0.7000	0.7700	104.9128 (77)
Southwest	13.3500	36.7938	0.6300	0.7000	0.7700	150.1164 (79)
Northwest	5.1200	11.2829	0.6300	0.7000	0.7700	17.6549 (81)
Northeast	1.7200	18.0708	0.6300	0.7000	1.0000	12.3364 (82)
Southwest	1.2900	34.0172	0.6300	0.7000	1.0000	17.4168 (82)

Solar gains	346.6089	620.0718	925.3125	1272.3013	1537.6537	1575.4495	1498.5893	1293.5436	1044.5694	706.2303	420.6066	293.0741 (83)
Total gains	910.7689	1182.7484	1467.8832	1781.1740	2009.8107	2014.1977	1916.8865	1716.1778	1485.6105	1181.1253	934.5287	838.6708 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
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	64.0753	64.1867	64.2962	64.8157	64.9138	65.3745	65.3745	65.4605	65.1963	64.9138	64.7156	64.5097
alpha	5.2717	5.2791	5.2864	5.3210	5.3276	5.3583	5.3583	5.3640	5.3464	5.3276	5.3144	5.3006
util living area	0.9998	0.9991	0.9958	0.9777	0.9061	0.7447	0.5731	0.6540	0.9063	0.9929	0.9994	0.9999 (86)
MIT	19.6386	19.8099	20.0872	20.4533	20.7719	20.9452	20.9890	20.9788	20.8319	20.4034	19.9484	19.6097 (87)
Th 2	20.0141	20.0156	20.0171	20.0242	20.0256	20.0318	20.0318	20.0329	20.0294	20.0256	20.0229	20.0201 (88)
util rest of house	0.9997	0.9988	0.9942	0.9686	0.8683	0.6579	0.4545	0.5318	0.8525	0.9889	0.9992	0.9998 (89)
MIT 2	18.7543	18.9266	19.2044	19.5707	19.8669	20.0059	20.0289	20.0265	19.9282	19.5265	19.0711	18.7302 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	18.8306	19.0028	19.2806	19.6469	19.9449	20.0869	20.1117	20.1087	20.0062	19.6021	19.1468	18.8060 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8306	19.0028	19.2806	19.6469	19.9449	20.0869	20.1117	20.1087	20.0062	19.6021	19.1468	18.8060 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9996	0.9983	0.9926	0.9640	0.8646	0.6633	0.4646	0.5420	0.8509	0.9864	0.9998	0.9997 (94)
Useful gains	910.3949	1180.7339	1456.9655	1716.9910	1737.6114	1336.0779	890.6475	930.1380	1264.0355	1165.0300	933.4398	838.4504 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W												
Month fracti	3795.1421	3677.0296	3326.6088	2774.8452	2125.6268	1404.6201	898.9712	948.1483	1516.0705	2320.8350	3115.2909	3789.1726 (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	2146.2519	1677.5107	1391.0146	761.6550	288.6835	0.0000	0.0000	0.0000	0.0000	859.9189	1570.9328	2195.3374 (98)
Space heating per m2												10891.3047 (98)
												(98) / (4) = 45.1940 (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												



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2406.3346	1894.3485	1942.9900	0.0000	0.0000	0.0000	0.0000	(100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8535	0.9186	0.8788	0.0000	0.0000	0.0000	0.0000	(101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2053.7732	1740.1908	1707.5215	0.0000	0.0000	0.0000	0.0000	(102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	2469.8145	2354.3960	2129.5885	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	299.5497	456.9687	314.0179	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction												1070.5362	(104)
Intermittency factor (Table 10b)												1.0000	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	74.8874	114.2422	78.5045	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling per m2												267.6341	(107)
Energy for space heating												1.1106	(108)
Energy for space cooling												45.1940	(99)
Total												1.1106	(108)
Target Fabric Energy Efficiency (TFEE)												46.3046	(109)
												53.3	(109)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				0.0000 / (5) =	0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (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) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	5.0000	4.9000	4.3000	4.2000	3.9000	3.7000	3.5000	3.9000	4.2000	4.5000	4.7000 (22)
Wind factor	1.2500	1.2500	1.2250	1.0750	1.0500	0.9750	0.9250	0.8750	0.9750	1.0500	1.1250	1.1750 (22a)
Adj infiltr rate	0.2656	0.2656	0.2603	0.2284	0.2231	0.2072	0.1966	0.1859	0.2072	0.2231	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5156	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26)
Opening Type 2 (Uw = 1.60)			40.6100	1.5038	61.0677		(27)
Opening Type 3 (Uw = 1.60)			3.0100	1.5038	4.5263		(27a)
Heat Loss Floor 1			103.7000	0.1300	13.4810	75.0000	7777.5000 (28a)
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820	110.0000	21439.0000 (29a)
Sheltered Room in Roof Wall	25.0000		25.0000	0.1200	3.0000	9.0000	225.0000 (29a)
External Roof 1	70.6600	3.0100	67.6500	0.1700	11.5005	0.0000	0.0000 (30)
External Roof 2	10.7800		10.7800	0.1300	1.4014	9.0000	97.0200 (30)
Sheltered Plane Roof	30.2900		30.2900	0.1200	3.6348	9.0000	272.6100 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	137.5097		(33)
Internal Wall 1			87.3200			75.0000	6549.0000 (32c)
Internal Wall 2			204.5100			9.0000	1840.5900 (32c)
Internal Floor 1			83.7900			18.0000	1508.2200 (32d)
Internal Floor 2			53.5000			18.0000	963.0000 (32d)
Internal Ceiling 1			83.7900			18.0000	1508.2200 (32e)
Internal Ceiling 2			53.5000			18.0000	963.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	43143.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							179.0247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							35.3473 (36)
Total fabric heat loss						(33) + (36) =	172.8570 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	102.2209	102.2209	101.1677	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233 (38)
Heat transfer coeff	275.0779	275.0779	274.0247	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803 (39)
Average = Sum(39)m / 12 =												272.6669 (39)
HLP	1.1414	1.1414	1.1371	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286 (40)
HLP (average)												1.1314 (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												3.0552 (42)
Average daily hot water use (litres/day)												106.7614 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Energy content (annual)	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Distribution loss (46)m = 0.15 x (45)m	26.1235	22.8478	23.5768	20.5549	19.7229	17.0193	15.7709	18.0974	18.3135	21.3426	23.2971	25.2992 (46)
Water storage loss:												
Store volume												300.0000 (47)
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103 (51)
Volume factor from Table 2a												0.7368 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												1.2281 (55)
Total storage loss	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (56)
If cylinder contains dedicated solar storage	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (64)
Total per year (kWh/year) = Sum(64)m =												2401.9097 (64)
RHI water heating demand												2402 (64)
Heat gains from water heating, kWh/month	106.9728	94.9633	101.3277	93.0463	92.7848	85.2092	84.0246	89.1816	88.0779	96.3752	99.1250	105.1456 (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	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7082	82.3426	66.9655	50.6972	37.8967	31.9940	34.5707	44.9363	60.3134	76.5817	89.3821	95.2848 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	609.7107	616.0376	600.0941	566.1521	523.3065	483.0377	456.1356	449.8087	465.7523	499.6942	542.5398	582.8087 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865 (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)	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)	143.7806	141.3145	136.1932	129.2309	124.7107	118.3461	112.9363	119.8677	122.3304	129.5366	137.6736	141.3248 (72)
Total internal gains	966.6904	960.1855	923.7436	866.5711	806.4048	753.8687	724.1335	735.1036	768.8869	826.3034	890.0864	939.9091 (73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	12.8100	10.4427	0.7600	0.7000	0.7700	49.3180 (75)
Southeast	9.3300	34.4805	0.7600	0.7000	0.7700	118.6043 (77)
Southwest	13.3500	34.4805	0.7600	0.7000	0.7700	169.7072 (79)
Northwest	5.1200	10.4427	0.7600	0.7000	0.7700	19.7118 (81)
Northeast	1.7200	16.6839	0.7600	0.7000	1.0000	13.7398 (82)
Southwest	1.2900	31.5636	0.7600	0.7000	1.0000	19.4953 (82)

Solar gains	390.5764	700.1193	1090.3760	1511.7954	1811.7347	1837.5992	1744.8936	1486.9401	1213.8069	795.3063	451.1063	323.7626 (83)
Total gains	1357.2668	1660.3049	2014.1196	2378.3664	2618.1395	2591.4678	2469.0271	2222.0437	1982.6938	1621.6096	1341.1927	1263.6717 (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	43.5666	43.5666	43.7341	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628
alpha	3.9044	3.9044	3.9156	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375
util living area	0.9948	0.9886	0.9709	0.9232	0.8235	0.6930	0.5945	0.6605	0.8415	0.9623	0.9909	0.9960 (86)
MIT	19.6332	19.7847	20.0646	20.4032	20.6869	20.8389	20.8898	20.8691	20.7185	20.3377	19.9204	19.6053 (87)
Th 2	19.9671	19.9671	19.9707	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775 (88)
util rest of house	0.9935	0.9859	0.9640	0.9049	0.7825	0.6239	0.5055	0.5722	0.7912	0.9501	0.9884	0.9951 (89)
MIT 2	18.1214	18.3418	18.7491	19.2336	19.6137	19.7965	19.8465	19.8313	19.6643	19.1508	18.5487	18.0883 (90)
Living area fraction												fLA = Living area / (4) = 0.0863 (91)
MIT	18.2518	18.4663	18.8626	19.3345	19.7062	19.8864	19.9383	19.9208	19.7552	19.2532	18.6670	18.2192 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1018	18.3163	18.7126	19.1845	19.5562	19.7364	19.7883	19.7708	19.6052	19.1032	18.5170	18.0692 (93)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9901	0.9799	0.9527	0.8873	0.7630	0.6059	0.4878	0.5525	0.7692	0.9359	0.9831	0.9924 (94)
Useful gains	1343.8965	1626.8705	1918.8579	2110.3354	1997.5161	1570.2173	1204.4028	1227.7470	1525.0105	1517.6116	1318.4663	1254.0769 (95)
Ext temp.	3.6000	4.0000	5.5000	7.8000	10.7000	13.5000	15.2000	15.0000	12.8000	9.5000	6.3000	3.5000 (96)
Heat loss rate W	3989.1304	3938.0980	3620.5832	3096.3511	2408.7247	1696.1900	1247.9346	1297.5711	1850.8867	2611.8752	3322.7807	3962.5378 (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	1968.0540	1553.1449	1266.0836	709.9313	305.9392	0.0000	0.0000	0.0000	0.0000	814.1321	1443.1064	2015.0950 (98)
Space heating												10075.4865 (98)
RHI space heating demand												10075 (98)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = {6a}+{6b}+{7a}+{7b}+{7c} =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (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) = 0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26)
Opening Type 2 (Uw = 1.60)			40.6100	1.5038	61.0677		(27)
Opening Type 3 (Uw = 1.60)			3.0100	1.5038	4.5263		(27a)
Heat Loss Floor 1			103.7000	0.1300	13.4810	75.0000	7777.5000 (28a)
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820	110.0000	21439.0000 (29a)
Sheltered Room in Roof Wall	25.0000		25.0000	0.1200	3.0000	9.0000	225.0000 (29a)
External Roof 1	70.6600	3.0100	67.6500	0.1700	11.5005	0.0000	0.0000 (30)
External Roof 2	10.7800		10.7800	0.1300	1.4014	9.0000	97.0200 (30)
Sheltered Plane Roof	30.2900		30.2900	0.1200	3.6348	9.0000	272.6100 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 137.5097		(33)
Internal Wall 1			87.3200			75.0000	6549.0000 (32c)
Internal Wall 2			204.5100			9.0000	1840.5900 (32c)
Internal Floor 1			83.7900			18.0000	1508.2200 (32d)
Internal Floor 2			53.5000			18.0000	963.0000 (32d)
Internal Ceiling 1			83.7900			18.0000	1508.2200 (32e)
Internal Ceiling 2			53.5000			18.0000	963.0000 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 43143.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							179.0247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							35.3473 (36)
Total fabric heat loss							(33) + (36) = 172.8570 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	103.2741	102.2209	101.1677	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233 (38)
Heat transfer coeff	276.1310	275.0779	274.0247	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803 (39)
Average = Sum(39)m / 12 =												272.7547 (39)
HLP	1.1458	1.1414	1.1371	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286 (40)
HLP (average)												1.1318 (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												3.0552 (42)
Average daily hot water use (litres/day)												106.7614 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Energy content (annual)	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Distribution loss (46)m = 0.15 x (45)m	26.1235	22.8478	23.5768	20.5549	19.7229	17.0193	15.7709	18.0974	18.3135	21.3426	23.2971	25.2992 (46)
Water storage loss:												
Store volume												300.0000 (47)
b) If manufacturer declared loss factor is not known:												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103 (51)
Volume factor from Table 2a												0.7368 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												1.2281 (55)
Total storage loss	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (56)
If cylinder contains dedicated solar storage	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (64)
Total per year (kWh/year) = Sum(64)m =												2401.9097 (64)
Heat gains from water heating, kWh/month	106.9728	94.9633	101.3277	93.0463	92.7848	85.2092	84.0246	89.1816	88.0779	96.3752	99.1250	105.1456 (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	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7082	82.3426	66.9655	50.6972	37.8967	31.9940	34.5707	44.9363	60.3134	76.5817	89.3821	95.2848 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	609.7107	616.0376	600.0941	566.1521	523.3065	483.0377	456.1356	449.8087	465.7523	499.6942	542.5398	582.8087 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865 (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)	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)	143.7806	141.3145	136.1932	129.2309	124.7107	118.3461	112.9363	119.8677	122.3304	129.5366	137.6736	141.3248 (72)
Total internal gains	966.6904	960.1855	923.7436	866.5711	806.4048	753.8687	724.1335	735.1036	768.8869	826.3034	890.0864	939.9091 (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	12.8100	11.2829	0.7600	0.7000	0.7700	53.2864 (75)						
Southeast	9.3300	36.7938	0.7600	0.7000	0.7700	126.5615 (77)						
Southwest	13.3500	36.7938	0.7600	0.7000	0.7700	181.0928 (79)						
Northwest	5.1200	11.2829	0.7600	0.7000	0.7700	21.2979 (81)						
Northeast	1.7200	18.0708	0.7600	0.7000	1.0000	14.8820 (82)						
Southwest	1.2900	34.0172	0.7600	0.7000	1.0000	21.0108 (82)						
Solar gains	418.1314	748.0231	1116.2501	1534.8397	1854.9473	1900.5422	1807.8221	1560.4653	1260.1155	851.9603	507.3985	353.5497 (83)
Total gains	1384.8217	1708.2086	2039.9937	2401.4108	2661.3521	2654.4109	2531.9555	2295.5688	2029.0024	1678.2637	1397.4848	1293.4588 (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	43.4004	43.5666	43.7341	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628
alpha	3.8934	3.9044	3.9156	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375
util living area	0.9935	0.9850	0.9628	0.9009	0.7767	0.6068	0.4593	0.5211	0.7652	0.9437	0.9874	0.9950 (86)
MIT	19.7100	19.8937	20.1714	20.5043	20.7562	20.8821	20.9185	20.9105	20.8086	20.4598	20.0220	19.6881 (87)
Th 2	19.9636	19.9671	19.9707	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775 (88)
util rest of house	0.9919	0.9813	0.9536	0.8767	0.7260	0.5260	0.3585	0.4154	0.6934	0.9246	0.9837	0.9938 (89)
MIT 2	18.2311	18.5005	18.9029	19.3735	19.6999	19.8402	19.8709	19.8662	19.7706	19.3229	18.6966	18.2095 (90)
Living area fraction												fLA = Living area / (4) =
MIT	18.3587	18.6207	19.0123	19.4710	19.7910	19.9301	19.9613	19.9563	19.8602	19.4210	18.8109	18.3370 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.2087	18.4707	18.8623	19.3210	19.6410	19.7801	19.8113	19.8063	19.7102	19.2710	18.6609	18.1870 (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	0.9879	0.9738	0.9405	0.8577	0.7071	0.5093	0.3415	0.3967	0.6716	0.9071	0.9768	0.9905	(94)
Useful gains	1368.0198	1663.4647	1918.5682	2059.6762	1881.7740	1351.7867	864.7062	910.7560	1362.7203	1522.4306	1365.0251	1281.1946	(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													
	3840.6146	3732.9933	3387.5825	2834.3123	2159.7938	1408.8719	873.4097	926.4475	1525.8538	2358.3392	3144.3415	3804.1965	(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													
	1839.6105	1390.7232	1092.9466	557.7380	206.8467	0.0000	0.0000	0.0000	0.0000	621.9160	1281.1078	1877.1134	(98)
Space heating													
per m2											(98) / (4) =	8868.0022	(98)
												36.7982	(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)													0.1000	(201)	
Fraction of space heat from main system(s)														0.9000	(202)
Efficiency of main space heating system 1 (in %)														89.0000	(206)
Efficiency of secondary/supplementary heating system, %														65.0000	(208)
Space heating requirement														8967.6426	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Space heating requirement	1839.6105	1390.7232	1092.9466	557.7380	206.8467	0.0000	0.0000	0.0000	0.0000	621.9160	1281.1078	1877.1134	(98)		
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)		
Space heating fuel (main heating system)	1860.2803	1406.3493	1105.2269	564.0047	209.1708	0.0000	0.0000	0.0000	0.0000	628.9038	1295.5022	1898.2045	(211)		
Water heating requirement	283.0170	213.9574	168.1456	85.8058	31.8226	0.0000	0.0000	0.0000	0.0000	95.6794	197.0935	288.7867	(215)		
Water heating requirement	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934	(64)		
Efficiency of water heater (217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(216)		
Fuel for water heating, kWh/month	264.5940	233.3879	245.5181	220.6586	216.6495	194.1753	187.0468	204.4734	203.8694	228.7824	241.2000	258.4196	(219)		
Water heating fuel used													2698.7749	(219)	
Annual totals kWh/year															
Space heating fuel - main system													8967.6426	(211)	
Space heating fuel - secondary													1364.3080	(215)	
Electricity for pumps and fans:															
(MEV)Decentralised, Database: total watage = 12.1440, total flow = 66.0000, SFP = 0.1840)															
mechanical ventilation fans (SFP = 0.1840)													134.8557	(230a)	
central heating pump													30.0000	(230c)	
main heating flue fan													45.0000	(230e)	
Total electricity for the above, kWh/year													209.8557	(231)	
Electricity for lighting (calculated in Appendix L)													654.9022	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)															
PV Unit 0 (0.80 * 2.00 * 1029 * 1.00) =										-1646.6987			-1646.6987	(233)	
Total delivered energy for all uses													12248.7847	(238)	

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	8967.6426	3.4800	312.0740	(240)
Space heating - secondary	1364.3080	4.2300	57.7102	(242)
Water heating (other fuel)	2698.7749	3.4800	93.9174	(247)
Mechanical ventilation fans	134.8557	13.1900	17.7875	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	654.9022	13.1900	86.3816	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1646.6987	13.1900	-217.1996	(252)
Total energy cost			480.5636	(255)

#### 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7057	(257)
SAP value		90.1548	
SAP rating (Section 12)		90	(258)
SAP band		B	

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

Energy	Emission factor	Emissions
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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	8967.6426	0.2160	1937.0108 (261)
Space heating - secondary	1364.3080	0.0190	25.9219 (263)
Water heating (other fuel)	2698.7749	0.2160	582.9354 (264)
Space and water heating			2545.8680 (265)
Pumps and fans	209.8557	0.5190	108.9151 (267)
Energy for lighting	654.9022	0.5190	339.8942 (268)
Energy saving/generation technologies			
PV Unit	-1646.6987	0.5190	-854.6366 (269)
Total kg/year			2140.0407 (272)
CO2 emissions per m2			8.8800 (273)
EI value			89.9729
EI rating			90 (274)
EI band			B

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 Calculation of stars for heating and DHW  
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Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.25) / 0.8900 = 4.194$ , stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.25) / 0.8900 = 0.2603$ , stars = 4
Water heating energy efficiency	$3.48 / 0.8900 = 3.910$ , stars = 4
Water heating environmental impact	$0.216 / 0.8900 = 0.2427$ , stars = 4

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.7000 (1b)	x 2.6600 (2b)	= 275.8420 (1b) - (3b)
First floor	83.7900 (1c)	x 2.6900 (2c)	= 225.3951 (1c) - (3c)
Second floor	53.5000 (1d)	x 1.8600 (2d)	= 99.5100 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	240.9900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 600.7471 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (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) =				0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	5.0000	4.9000	4.3000	4.2000	3.9000	3.7000	3.5000	3.9000	4.2000	4.5000	4.7000 (22)
Wind factor	1.2500	1.2500	1.2250	1.0750	1.0500	0.9750	0.9250	0.8750	0.9750	1.0500	1.1250	1.1750 (22a)
Adj infiltr rate	0.2656	0.2656	0.2603	0.2284	0.2231	0.2072	0.1966	0.1859	0.2072	0.2231	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5156	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26)
Opening Type 2 (Uw = 1.60)			40.6100	1.5038	61.0677		(27)
Opening Type 3 (Uw = 1.60)			3.0100	1.5038	4.5263		(27a)
Heat Loss Floor 1			103.7000	0.1300	13.4810	75.0000	7777.5000 (28a)
External Wall 1	237.6300	42.7300	194.9000	0.1800	35.0820	110.0000	21439.0000 (29a)
Sheltered Room in Roof Wall	25.0000		25.0000	0.1200	3.0000	9.0000	225.0000 (29a)
External Roof 1	70.6600	3.0100	67.6500	0.1700	11.5005	0.0000	0.0000 (30)
External Roof 2	10.7800		10.7800	0.1300	1.4014	9.0000	97.0200 (30)
Sheltered Plane Roof	30.2900		30.2900	0.1200	3.6348	9.0000	272.6100 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			478.0600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	137.5097			(33)
Internal Wall 1			87.3200			75.0000	6549.0000 (32c)
Internal Wall 2			204.5100			9.0000	1840.5900 (32c)
Internal Floor 1			83.7900			18.0000	1508.2200 (32d)
Internal Floor 2			53.5000			18.0000	963.0000 (32d)
Internal Ceiling 1			83.7900			18.0000	1508.2200 (32e)
Internal Ceiling 2			53.5000			18.0000	963.0000 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	43143.1600 (34)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K				179.0247 (35)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				35.3473 (36)			
Total fabric heat loss			(33) + (36) =	172.8570 (37)			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	102.2209	102.2209	101.1677	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233	99.1233 (38)
Heat transfer coeff	275.0779	275.0779	274.0247	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803	271.9803 (39)
Average = Sum(39)m / 12 =												272.6669 (39)
HLP	1.1414	1.1414	1.1371	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286	1.1286 (40)
HLP (average)												1.1314 (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												3.0552 (42)
Average daily hot water use (litres/day)												106.7614 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.4375	113.1671	108.8966	104.6262	100.3557	96.0853	96.0853	100.3557	104.6262	108.8966	113.1671	117.4375 (44)
Energy content (annual)	174.1565	152.3184	157.1789	137.0324	131.4858	113.4623	105.1395	120.6491	122.0900	142.2842	155.3143	168.6613 (45)
Distribution loss (46)m = 0.15 x (45)m	26.1235	22.8478	23.5768	20.5549	19.7229	17.0193	15.7709	18.0974	18.3135	21.3426	23.2971	25.2992 (46)
Water storage loss:												
Store volume												300.0000 (47)
b) If manufacturer declared loss factor is not known:												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103 (51)
Volume factor from Table 2a												0.7368 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												1.2281 (55)
Total storage loss	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (56)
If cylinder contains dedicated solar storage	38.0698	34.3856	38.0698	36.8417	38.0698	36.8417	38.0698	38.0698	36.8417	38.0698	36.8417	38.0698 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (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	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934 (64)
Total per year (kWh/year) = Sum(64)m =												2401.9097 (64)
Heat gains from water heating, kWh/month	106.9728	94.9633	101.3277	93.0463	92.7848	85.2092	84.0246	89.1816	88.0779	96.3752	99.1250	105.1456 (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	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130	183.3130 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7082	82.3426	66.9655	50.6972	37.8967	31.9940	34.5707	44.9363	60.3134	76.5817	89.3821	95.2848 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	609.7107	616.0376	600.0941	566.1521	523.3065	483.0377	456.1356	449.8087	465.7523	499.6942	542.5398	582.8087 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865	56.3865 (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)	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087	-122.2087 (71)
Water heating gains (Table 5)	143.7806	141.3145	136.1932	129.2309	124.7107	118.3461	112.9363	119.8677	122.3304	129.5366	137.6736	141.3248 (72)
Total internal gains	966.6904	960.1855	923.7436	866.5711	806.4048	753.8687	724.1335	735.1036	768.8869	826.3034	890.0864	939.9091 (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	12.8100	10.4427	0.7600	0.7000	0.7700	49.3180 (75)						
Southeast	9.3300	34.4805	0.7600	0.7000	0.7700	118.6043 (77)						
Southwest	13.3500	34.4805	0.7600	0.7000	0.7700	169.7072 (79)						
Northwest	5.1200	10.4427	0.7600	0.7000	0.7700	19.7118 (81)						
Northeast	1.7200	16.6839	0.7600	0.7000	1.0000	13.7398 (82)						
Southwest	1.2900	31.5636	0.7600	0.7000	1.0000	19.4953 (82)						
Solar gains	390.5764	700.1193	1090.3760	1511.7954	1811.7347	1837.5992	1744.8936	1486.9401	1213.8069	795.3063	451.1063	323.7626 (83)
Total gains	1357.2668	1660.3049	2014.1196	2378.3664	2618.1395	2591.4678	2469.0271	2222.0437	1982.6938	1621.6096	1341.1927	1263.6717 (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	43.5666	43.5666	43.7341	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628	44.0628
alpha	3.9044	3.9044	3.9156	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375	3.9375
util living area	0.9948	0.9886	0.9709	0.9232	0.8235	0.6930	0.5945	0.6605	0.8415	0.9623	0.9909	0.9960 (86)
MIT	19.6332	19.7847	20.0646	20.4032	20.6869	20.8389	20.8898	20.8691	20.7185	20.3377	19.9204	19.6053 (87)
Th 2	19.9671	19.9671	19.9707	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775	19.9775 (88)
util rest of house	0.9935	0.9859	0.9640	0.9049	0.7825	0.6239	0.5055	0.5722	0.7912	0.9501	0.9884	0.9951 (89)
MIT 2	18.1214	18.3418	18.7491	19.2336	19.6137	19.7965	19.8465	19.8313	19.6643	19.1508	18.5487	18.0883 (90)
Living area fraction												fLA = Living area / (4) = 0.0863 (91)
MIT	18.2518	18.4663	18.8626	19.3345	19.7062	19.8864	19.9383	19.9208	19.7552	19.2532	18.6670	18.2192 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1018	18.3163	18.7126	19.1845	19.5562	19.7364	19.7883	19.7708	19.6052	19.1032	18.5170	18.0692 (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	0.9901	0.9799	0.9527	0.8873	0.7630	0.6059	0.4878	0.5525	0.7692	0.9359	0.9831	0.9924	(94)
Useful gains	1343.8965	1626.8705	1918.8579	2110.3354	1997.5161	1570.2173	1204.4028	1227.7470	1525.0105	1517.6116	1318.4663	1254.0769	(95)
Ext temp.	3.6000	4.0000	5.5000	7.8000	10.7000	13.5000	15.2000	15.0000	12.8000	9.5000	6.3000	3.5000	(96)
Heat loss rate W	3989.1304	3938.0980	3620.5832	3096.3511	2408.7247	1696.1900	1247.9346	1297.5711	1850.8867	2611.8752	3322.7807	3962.5378	(97)
Month fractl	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	1968.0540	1553.1449	1266.0836	709.9313	305.9392	0.0000	0.0000	0.0000	0.0000	814.1321	1443.1064	2015.0950	(98)
Space heating												10075.4865	(98)
Space heating per m2												41.8087	(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)													0.1000	(201)		
Fraction of space heat from main system(s)														0.9000	(202)	
Efficiency of main space heating system 1 (in %)														89.0000	(206)	
Efficiency of secondary/supplementary heating system, %														65.0000	(208)	
Space heating requirement														10188.6942	(211)	
Space heating requirement	1968.0540	1553.1449	1266.0836	709.9313	305.9392	0.0000	0.0000	0.0000	0.0000	814.1321	1443.1064	2015.0950		(98)		
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000		(210)		
Space heating fuel (main heating system)	1990.1670	1570.5960	1280.3093	717.9081	309.3767	0.0000	0.0000	0.0000	0.0000	823.2797	1459.3211	2037.7365		(211)		
Water heating requirement	302.7775	238.9454	194.7821	109.2202	47.0676	0.0000	0.0000	0.0000	0.0000	125.2511	222.0164	310.0146		(215)		
Water heating requirement	235.4887	207.7152	218.5111	196.3861	192.8180	172.8160	166.4717	181.9813	181.4438	203.6163	214.6680	229.9934		(64)		
Efficiency of water heater (217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000		(216)		
Fuel for water heating, kWh/month	264.5940	233.3879	245.5181	220.6586	216.6495	194.1753	187.0468	204.4734	203.8694	228.7824	241.2000	258.4196		(219)		
Water heating fuel used												2698.7749		(219)		
Annual totals kWh/year																
Space heating fuel - main system														10188.6942	(211)	
Space heating fuel - secondary														1550.0748	(215)	
Electricity for pumps and fans:																
(MEV)Decentralised, Database: total watage = 12.1440, total flow = 66.0000, SFP = 0.1840)																
mechanical ventilation fans (SFP = 0.1840)															134.8557	(230a)
central heating pump															30.0000	(230c)
main heating flue fan															45.0000	(230e)
Total electricity for the above, kWh/year															209.8557	(231)
Electricity for lighting (calculated in Appendix L)															654.9022	(232)
Energy saving/generation technologies (Appendices M ,N and Q)																
PV Unit 0 (0.80 * 2.00 * 988 * 1.00) =															-1580.6274	(233)
Total delivered energy for all uses															13721.6745	(238)

#### 10a. Fuel costs - using BEDF prices (500)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	10188.6942	3.6300	369.8496	(240)
Space heating - secondary	1550.0748	5.1600	79.9839	(242)
Water heating (other fuel)	2698.7749	3.6300	97.9655	(247)
Mechanical ventilation fans	134.8557	19.4400	26.2159	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	654.9022	19.4400	127.3130	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1580.6274	19.4400	-307.2740	(252)
Total energy cost			503.6340	(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	10188.6942	0.2160	2200.7580	(261)
Space heating - secondary	1550.0748	0.0190	29.4514	(263)
Water heating (other fuel)	2698.7749	0.2160	582.9354	(264)
Space and water heating			2813.1448	(265)
Pumps and fans	209.8557	0.5190	108.9151	(267)
Energy for lighting	654.9022	0.5190	339.8942	(268)
Energy saving/generation technologies				
PV Unit	-1580.6274	0.5190	-820.3456	(269)
Total kg/year			2441.6085	(272)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	10188.6942	1.2200	12430.2070 (261)
Space heating - secondary	1550.0748	1.0400	1612.0778 (263)
Water heating (other fuel)	2698.7749	1.2200	3292.5054 (264)
Space and water heating			17334.7902 (265)
Pumps and fans	209.8557	3.0700	644.2570 (267)
Energy for lighting	654.9022	3.0700	2010.5496 (268)
Energy saving/generation technologies			
PV Unit	-1580.6274	3.0700	-4852.5260 (269)
Primary energy kWh/year			15137.0708 (272)
Primary energy kWh/m2/year			62.8120 (273)

#### SAP 2012 EPC IMPROVEMENTS

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

(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	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures: (none) SAP change Cost change CO2 change

Measures omitted - SAP change or cost saving too small:  
 N Solar water heating + 0.7 -£ 34 -237 kg (9.7%)

Recommended measures (none) Typical annual savings Energy Environmental efficiency impact  
 Total Savings £0 0.00 kg/m²

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

Fuel prices for cost data on this page from database revision number 500 TEST (30 Jun 2022)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£168	£168	£0
Mains gas	£563	£563	£0
Wood	£80	£80	£0
Space heating	£586	£586	£0
Water heating	£98	£98	£0
Lighting	£127	£127	£0
Generated (PV)	-£307	-£307	£0
Total cost of fuels	£504	£504	£0

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Total cost of uses	£504	£504	£0
Delivered energy	57 kWh/m <sup>2</sup>	57 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	2.4 tonnes	2.4 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	10 kg/m <sup>2</sup>	10 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	63 kWh/m <sup>2</sup>	63 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014  
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No improvements selected / applicable

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# 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

No improvements selected / applicable

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

#### Overheating Calculation Input Data

Dwelling type Detached House  
 Number of storeys 3  
 Cross ventilation possible No  
 SAP Region North East England  
 Front of dwelling faces North West  
 Overshading Average or unknown  
 Thermal mass parameter 179.0 (calculated from construction elements)  
 Night ventilation No  
 Ventilation rate during hot weather (ach) 2.50 (Windows half open)

#### Overheating Calculation

Summer ventilation heat loss coefficient 495.62 (P1)  
 Transmission heat loss coefficient 172.86 (37)  
 Summer heat loss coefficient 668.47 (P2)

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

Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	0.800	0.90	1.000	0.720 (P8)
North East	0.800	1.00	1.000	0.800 (P8)
South East	0.800	0.90	1.000	0.720 (P8)
South West	0.800	0.90	1.000	0.720 (P8)
South West	0.800	1.00	1.000	0.800 (P8)
North West	0.800	0.90	1.000	0.720 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	FF Specific data or Table 6c	Shading	Gains W
North East	12.8100	91.1383	0.7600	0.7000	0.7200	402.4727
South East	9.3300	115.6809	0.7600	0.7000	0.7200	372.0746
South West	13.3500	115.6809	0.7600	0.7000	0.7200	532.3897
North West	5.1200	91.1383	0.7600	0.7000	0.7200	160.8634
North East	1.7200	163.5072	0.7600	0.7000	0.8000	107.7232
South West	1.2900	193.3062	0.7600	0.7000	0.8000	95.5168

	Jun	Jul	Aug	
Solar gains	1729	1671	1431	(P3)
Internal gains	751	721	732	
Total summer gains	2480	2392	2163	(P5)
Summer gain/loss ratio	3.71	3.58	3.24	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 179.0)	0.75	0.75	0.75	
Threshold temperature	18.26	20.13	19.58	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature:	Not significant			